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PREFACE

This textbook conforms broadly to the curriculum framework and guidelines provided. However, some changes have been made in both approach and content in the light of feedback from teachers who have already taught from the Science textbooks for Standards VIII and IX introduced in 1992 and 1993, respectively.

In line with recent policy, this book reflects the integrated approach to teaching and learning science, with focus on environmental aspects. It calls for a reorientation in outlook as well as subject comprehension in those who are used to the discipline-oriented approach. Because of limitations on its size, the textbook cannot possibly be sufficiently comprehensive to everyone and may have to be supplemented with additional readings from books and encyclopedias on school level general science. If any new curriculum is to be implemented successfully, such extra demands, especially on teachers, is inevitable.

Chairman
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FOREWORD

This text book is prepared as per the syllabus framed based on National policy on Education 1986.The Core Elements and Human values that are stressed in the National policy on education are addressed at length in developing lessons.

The Directorate is greatful to all those who have participated in the production of this book.

The Text Books are reprinted after editing and making necessary corrections. The Directorate welcomes suggestions for further improvement of the book.

(M. Jalaja Bai)
DIRECTOR
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[*Note : The numbers shown in brackets are the estimated number of teaching periods for the respective chapters. They are only suggestive. Teachers may like to modify them suitably, depending on various considerations.*]

UNIT I : ENVIRONMENT

Chapter 1 : BIOSPHERE, BIOMES AND ECOSYSTEMS

Introduction

The term environment includes those natural things that surround us. The various natural things comprise living and non-living objects, events and influences, the totality of which constitutes the **environment.** All organisms–microbes, plants and animals, including man depend on the environment for their sustenance. Life could originate and flourish on earth only because the environment of this planet provides the necessary conditions for it. You have studied elsewhere that the planet earth has undergone several changes since its formation. The environment of the earth millions of years ago was quite different from what it is today. However, it has always had two chief components–the **abiotic** and the **biotic.**

Abiotic components., also called physical components, include land, water, air and sunlight. The **biotic components** of the environment include microorganisms, plants, animals and human beings. There is always a close interaction between the biotic and the abiotic components of the environment. The organisms depend on their environment for energy, water, oxygen, shelter, food and other requirements. The relationships between the different factors are so smooth and often so subtle that we are not aware of its immense complexities. The environment and the organisms are both products of a continuous process of change. Changes in the environment are a natural phenomena. Ever since life began on earth, changes in the environment have influenced the type of organisms inhabiting the earth.

In the last few centuries, man has become the most dominant species on earth. This is due to his intelligence, tool making ability and his widening knowledge of science and technology. He has started interfering and tampering with the environment for his selfish needs. This has altered the natural process of change in the environment. He is

responsible for degrading the vital life supporting systems such as air, water and land. Increased human demand coupled with his short sightedness has disturbed the delicate natural balance in the environment. It is possible that his activities may cause major changes in the climate and vegetation patterns in future also. Thus, man has become not only the dominant species on the earth but also the greatest manipulator of the environment.

No organism is capable of living in all types of environments. Only man has the ability to modify, control and adapt suitably to any type of environment. He can live anywhere on earth, including Antarctica. He has even lived in outer space for short periods.

Biosphere

Organisms live in a variety of habitats such as land, fresh water, oceanic water and air. There is a hierarchy of organisation in nature comprising various levels from molecular to ecosystem and biosphere. These levels exhibit interaction and are mutually interdependent.

Biosphere is the thin mantle of the earth and the part of the atmosphere in which living organisms exist. It is the largest biological system comprising of all living and non-living components. On account of this, biosphere is sometimes defined as the sphere of living matter together with water, air and soil which they inhabit. Each component of the biosphere has certain specific functions. The totality of all such functions gives the biosphere a functional stability.

To understand the structure and function of the biosphere, developing familiarity with the following concepts is necessary. Sum of Individuals of any species at a particular place form its **population** (eg : human population). The various populations of different organisms in a particular area form a **community.** For example, populations of teak wood, rose wood and other trees in the forest constitute a community. Communities of animals and plants interact among themselves and with their physical environment as a functional unit. This interaction of living and non-living components as a system is called an **ecosystem** (eg : pond, lakes or forest). Ponds and lakes are examples of **aquatic** ecosystems and forest is an example of a **terrestrial** ecosystem. Bigger biotic communities or ecosystems spread over a large geographical area are called **biomes** (*eg :* the desert biome, the tropical rain forest biome).

All the biomes of the earth are inter-related and they interact together as a bigger unit constituting a single large self- sustaining biological system called the **biosphere**. The biosphere thus includes all microorganisms, plants, animals and human beings.

Biomes

Biomes can be **terrestrial** or **aquatic**. Terrestrial biomes include the *tropical rain forest biome, deciduous forest biome, grassland biome, coniferous forest biome and the tundra biome.* **Sea** and **rivers** are examples of aquatic biomes.

The distribution of biomes is largely determined by factors like precipitation, temperature, light and other climatic factors. For example, in the temperate and tropical latitudes of the world, variations in rainfall determine the type of biome. In the tropics, evergreen forests exist in regions where the average annual rainfall is more than 200 cm. A rainfall of 100 to 200 cm. is enough for the deciduous forests. Grasslands develop in regions with a rainfall of less than 100 cm. A scanty rainfall of around 25 cm. can support only a desert biome.

Terrestrial Biomes

A. Tropical Evergreen Forest Biome or Rain Forest Biome

These forests occur on either side of the equator 10° North and 10° South in three principal regions of the world :

1. The Amazon and Orinoco basins in South America.
2. The Congo, Niger and the Zambezi basins of Africa.
3. The Indo-Malayan region.

The tropical rain forests contain more than half the world's flora and fauna. Plant and animal life finds greatest diversity in the rain forests. About 200 species of trees may be present per hectare. Forests are dense and multi-storied (figure 1.1) with tall and emergent trees reaching a height of 50 to 100 m. Very little light can filter through the dense layers of the canopy to support the undergrowth on the forest floor. Seasonal variations are absent. Bright sunshine and rainfall are spread throughout the year. A rich variety of epiphytes such as orchids, ferns and climbers grow in these forests. In India, a variation of tropical rain forest is found in the Western Ghats and in the North-East. In these evergreen forests timber yielding trees like ebony, rosewood and spice plants like cloves,

cinnamons and nutmegs grow abundantly. The fallen leaves on the forest floor form the litter, which under moist and partially decomposed condition supports a large number of saprophytes and decomposers.

Fig. 1.11 : Stratification of Trees in an Evergreen Forest
[a– Top Canopy of tall and emergent trees
b– Middle canopy of medium-sized trees
c–Lower Canopy of small trees]

Animal life includes ground dwellers and those living in the upper canopy of trees. Birds are the dominant vertebrates of the upper leaves. The arboreal mammals are generally the monkeys and lemurs. A large variety of insect species are found in these forests.

B. Deciduous Forest Biome

Deciduous forests can be seen in both tropical and temperate regions of the world.

Tropical deciduous forests occur in eastern Brazil, West Indies, Southern tropical belt of Africa, central plateau of India and the Western Ghats. The trees in these forests shed leaves during summer. The vegetation is less dense when compared to the evergreen forests. In the deciduous forests of the Western Ghats of Karnataka, animals such as elephants, bisons and leopards are found. Common trees include teak, sal, honne, sandal wood, gooseberry, palas and jamun.

Temperate deciduous forests are found in both the hemispheres. In these forests, winter is very severe and is usually snow covered. Broad leaved trees like elms, maples and oaks grow here. Animals of these forests include a variety of insects, spiders, birds and small mammals.

C. Grassland Biome

Grassland biomes occur both in the tropical and the temperate zones. The vegetation is dominated by grasses. A few herbs grow amidst the grasses.

Typical grasslands occur in South America (**pampas**). Africa (**tropical savanna**), North America (**prairies**), Australia (**downs**) and Russia (**steppes**). Natural grasslands are not seen in India. Only reduced types are found in Gujarat, foothills of the Himalayas and the Peninsular India. A large number of insect species, rodents including rabits, other herbivorous animals and snakes live in grasslands.

D. Desert Biome

Deserts occur in regions having less than 25 cms of annual rainfall. The major deserts in the world are the Sahara in Africa, the great Australian desert and deserts of the west Asian countries. In India, Thar in Rajasthan is a natural desert.

The vegetation is very sparse in deserts, consisting of hardy and spiny xerophytic herbs, shrubs and some grasses. The animal life includes camels, rabbits, rats, foxes, lizards, owls, hawks and snakes.

Tundra Biome

Tundra is essentially a wet arctic grassland. This biome is completely treeless. It is a marshy plain with lichens, mosses, grasses, sedges and small shrubs. Tundra is characterized by the permanently frozen deeper soil layer called the **permafrost.** In India, an Alpine tundra is found in the Himalayas. The vegetation supports a few species of insects, birds and mammals.

Aquatic Biomes

There are many kinds of aquatic biomes. They differ from one another with regard to their abiotic components. Factors like salinity, light, temperature, atmospheric pressure, pH, oxygen and other physicochemical features are important in determining the types of organisms. The sea or ocean is an excellent example of an aquatic

biome. The life in the sea can be grouped into three categories : **plankton, nekton and benthos**. Passively floating or drifting organisms are collectively called plankton. It consists of microscopic plants - **phytoplankton** (the primary producers) and animals - **zooplankton**. **Nekton** comprises actively moving organisms with well developed locomotor organs. They are active swimmers that feed on planktons or smaller nekton. Benthos or benthic organisms include the bottom dwellers that are usually creeping or crawling.

Activity 1.1 : Observation of Phytoplankton and Zooplankton

Collect a small sample of water from a nearby pond or lake. Take a drop of it on a glass slide. Put a cover glass on it and observe under the microscope. You may observe, microscopic phytoplankton and zooplankton. Identify them with the help of your teacher.

Ex :—Diatoms, Protozoans

Depending on the depth, temperature and other related physical factors, we recognize different ecological zones in the ocean. The **photic zone** or the sunlit zone has a large number of organisms including phytoplanktons (eg : diatoms and algae), the zooplanktons (protozoans, crustaceans like copepods and the larvae of multicellular organisms) and the nektons (large and small fish, whales and dolphins, turtles and snakes, squids and octopuses).

Below the photic zone is a vast area into which light does not penetrate. This area is called the **abyss** or area of permanent darkness. It has different types of consumers and decomposers but does not have the producers (the green plants). The fish that live here depend on fallouts from the upper layers of water.

The benthos live on the floor of oceans. They include creeping, crawling or attached animals (brittle stars, lobsters, sea cucumbers and others).

The seas and oceans are severely polluted because of the dumping of wastes and oil pollution. In fact, waste oil and debris of petroleum componds can be seen even in uninhabited islands in the Pacific and Atlantic, thousands of miles away from human habitation. Oil pollution reduces photosynthetic activity of phytoplanktons and causes diseases to the nekton and the benthos. Offshore oil operations, leakages while

pumping, cleaning of tankers and tanker accidents are the causes of oil pollution in oceans.

Ecosystem

The relationship between the biotic community (living) and the abiotic (non-living) environment is expressed as an **ecosystem**. Ecosystems are real like a pond, a field, a forest, an ocean or even an aquarium. There is a great diversity in the types of ecosystems from small to large, terrestrial to marine and fresh water, field to laboratory. In any ecosystem there are specific biotic and abiotic component. For example, in a pond ecosystem we have phytoplankton, zooplanton, aquatic insects, fish, frogs and snakes. The abiotic components include water, dissolved gaşes and minerals. The organisms that live in the pond ecosystem are not the same as the biotic components a forest or a desert. Nonetheless, they have in common certain general structural and functional attributes that are recognizable, and analyzable and predictable.

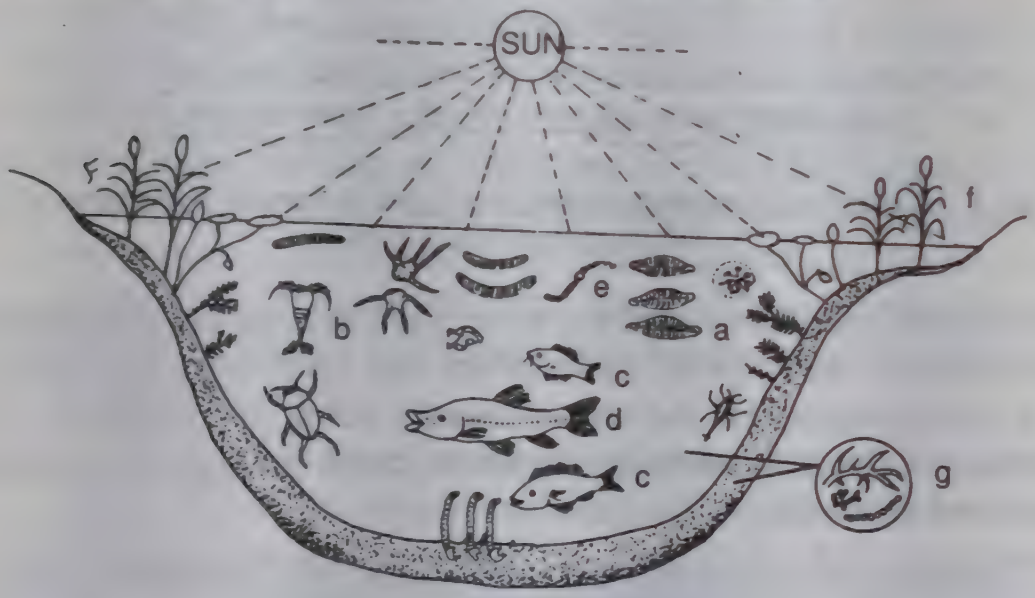

Fig. 1.2 : Diagrammatic Representation of Pond Ecosystem
(a) Phytoplankton, (b) Zoo plankton, (c) Small fish, (d) Big fish, (e) Floating plants, (f) Attached plants, (g) Action of decomposer

Rivers, streams, lakes and ponds are good examples of fresh water ecosystems. Marshes are typical wetland ecosystems.

The Sun is the ultimate source of energy for all the natural ecosystems. The green plants convert the radiant energy into chemical energy during photosynthesis. This energy and the nutrients obtained from the nutrient pool of the soil move from producers to herbivores; from

herbivores to carvivores and finally to decomposers. The decomposers act on the litter, decaying plants and animals and return the minerals to the nutrient pool (figure 1.3).

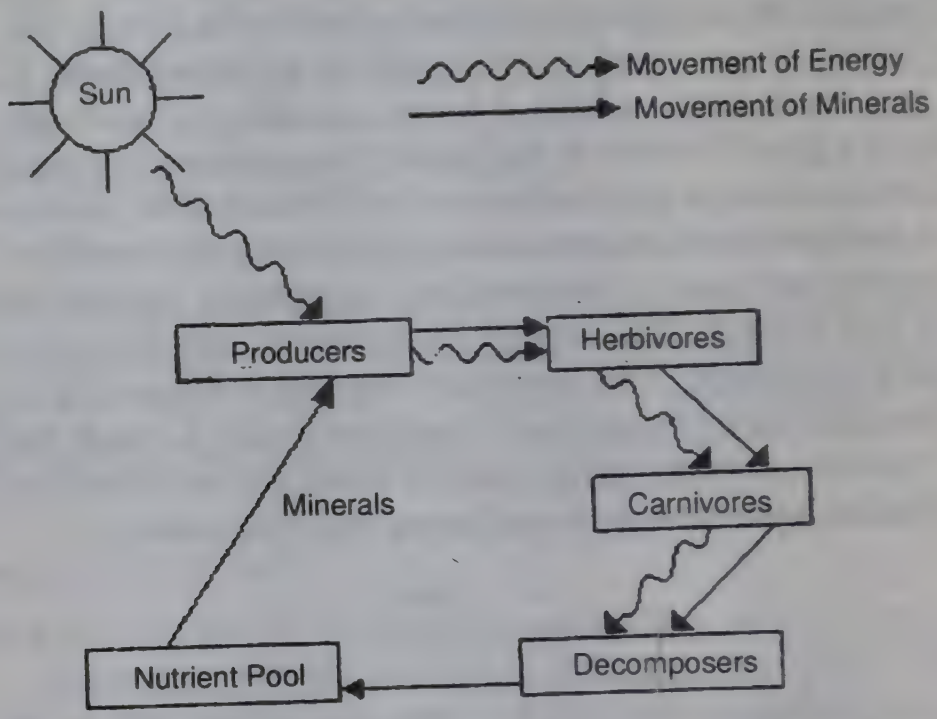

Fig 1.3 : Model of an Ecosystem showing the Cyclic Movement of Nutrients and the Unidirectional Flow of Energy

The biotic components of the ecosystem include the **producers** (all green plants - autotrophs), **consumers** (eg: herbivores and carnivores - the heterotrophs and the **decomposers** (fungi and bacteria). By the activities of decomposers, the nutrients cycle through the ecosystem again and again (fig. 1.3).

The abiotic components include the solids (eg: minerals), liquids (eg: water) and the gases (eg: oxygen, carbon dioxide). The biotic and abiotic components interact as a system. On account of this, to a considerable extent, ecosystems are self-regulating entities that have a high degree of homeostasis or equilibrium.

Any ecosystem is not a discrete entitiy delimited sharply from other ecosystems. They are mutually interconnected and interrelated. For example, a pond may be surrounded by a grassland or a forest or may be connected to another pond by a stream. The surrounding ecosystems may contribute organic matter or nutrient matter to an ecosystem. Sometimes migrations and complex feeding relationships of animals

Activity 1.2 : Study of an Ecosystem

Examine an aquarium in your school or house or anywhere else. List the non-living and living components. Discuss and answer the following questions : (a) Why is a frequent change of water necessary? (b) List the interactions between the biotic and abiotic components. (c) What happens when periodic external supplies are stopped? (d) Can we call the aquarium a complete ecosystem? (e) How does it differ from a natural ecosystem such as a pond? (f) What are the sources of nutrients and energy in the aquarium?

result in biological transfer of energy and nutrients from one ecosystem into another. The biosphere, therefore, is a gigantic network of ecosystems in which several types of associations exist between plants and plants, plants and animals and animals and animals. The rule however is that an orderly balance always exists between biotic and aboitic components of the ecosystems and in the biosphere.

One of the biotic components consistently seen in all ecosystems is man. His activities have disturbed the natural rhythm in ecosystems. He has cleared much of the natural forests and grasslands. He has established a large number of industries and is responsible for the pollution of air, water and soil. New and unnatural abiotic factors such as radioactive wastes, pesticides and other chemicals have been introduced by him. These pollutants have adversely affected our ecosystems. Plant, animal and human lives are being influenced by the above man-made hazards.

Scientists at NASA in the USA are trying to miniaturize the biosphere for spacecrafts. But so far, only a temporary system that can work for a few months has been achieved. The reason may be that we have not been able to understand the delicate and orderly balance that exists in the natural ecosystems and in the biosphere. We only know the structural and functional aspects of the ecosystems and not the delicate balances that control their interactions.

In all ecosystems of the biosphere, producers and consumers form the **food chain**.

Food Chain and Food Web

An interesting feature of all ecosystems is the interactions that exist between producers and consumers. This interaction is called the **food**

chain. The green plants convert the radiant energy into chemical energy (food) during photosynthesis by utilising simple raw materials like water and carbon dioxide in the presence of sunlight and chlorophyll.

The various steps in the food chain at which transfer of food (energy) takes place are called **trophic levels** (figure 1.4).

The figure shows a simple food chain with various trophic levels (T_1 to T_4). The first link in the food chain is always a producer. The second link is a herbivore that feeds on the producer. The third link is the secondary consumer which is a carnivore. The fourth link is also a carnivore. There is a flow of energy along with food materials from producers to successive levels of consumers (figure 1.4).

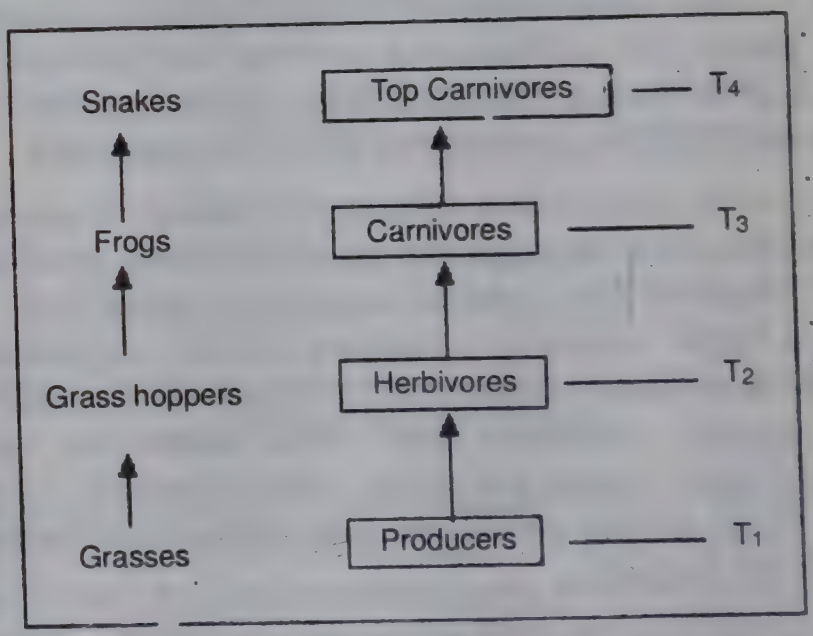

Fig 1.4: A Food Chain with Trophic Levels T_1 to T_4

In the above case, grasses represent the producers, grasshoppers consume grasses ; frogs eat the grasshoppers and frogs are in turn eaten by snakes.

Activity 1.3 : Construction of a Food Chain

Observe a water body such as a pond, lake or a river and list the organisms in it. Classify them into producers and consumers. Arrange them into different trophic levels. Construct a food chain with the biotic components identified in the water body.

The food chain in a pond ecosystem may be as follows (figure 1.5)

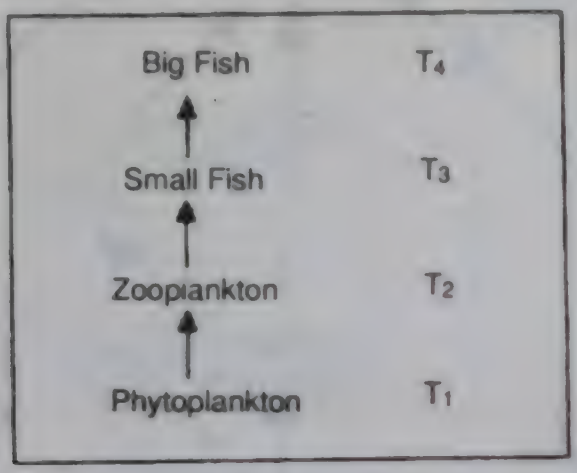

Fig. 1.5 : Food Chain in a pond Ecosystem

Through the food chains, nutrients and energy are transferred to different trophic levels.

Energy Flow

On an average, only about one percent of the total sun's energy reaching the earth's surface is utilized for photosynthesis by plants. In the food chains at various trophic levels, there is a loss of certain amount of energy in the form of heat. Further, the flow of energy is always unidirectional and gradually tapering, *i.e.*, the energy transferred to a trophic level is much less than that reaching the previous trophic level (figure 1.5).

Many food chains exist in an ecosystem. They are often inter connected by species which occur in more than one chain. The Interconnecting food chains that establish a network of species relationships constitute the **food web** (figure 1.6).

It is difficult to understand all the above relationships as they are intricate and complex. Direct, indirect and even delicate relationships exist between the various components of ecosystems.

Due to various kinds of pollution caused by man, food chains are often contaminated. Whether we like it or not, certain toxic chemicals like DDT and heavy metals (*eg:* lead, copper, mercury, chromium and cobalt) are entering our body. At each level of the food chain, chemicals like DDT can go on concentrating and finally a highly concentrated dose can enter our body. The cumulative concentration of such substances in food

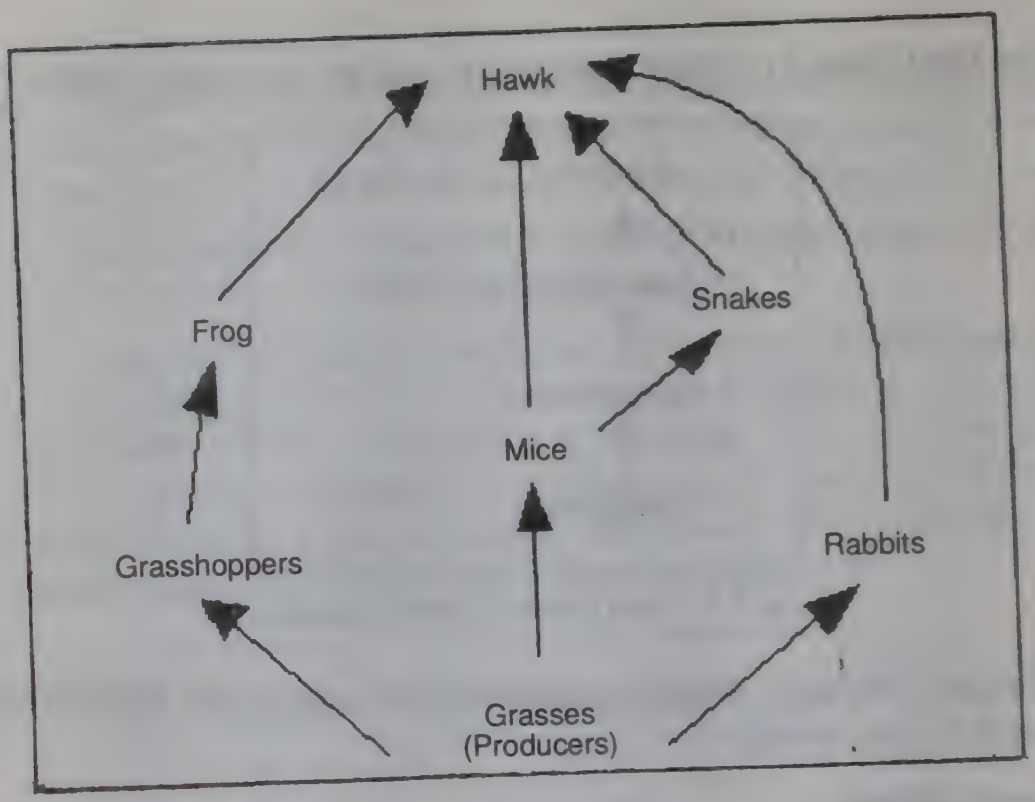

Fig. 1.6 : Schematic Representation of a Food–web

chains and their subsequent entry in large doses into our body is called **biomagnification**. Radio active materials can also move in the food chain in the same manner.

Man is known for manipulating and disturbing the food chains. Over grazing by cattle in grasslands results in the removal of useful producers. Destruction of forests results in the removal of trees and several useful species. His interference in the delicate predator-prey relationship through indiscriminate hunting has destroyed the 'biological balance.' There is always a harmonious relationship between the number of herbivores to carnivores in forests. The deer population would increase if the population of carnivores like tigers, lions and leopards are reduced. As a result of an increase in deer population, the producers will be under great stress. Their quality and quantity may also decrease. This in turn would starve the deer and reduce their population. Consequently, the populations of carnivores would also decrease. All these imbalances are caused due to man's undue inferference with the dynamics of nature. Such an interference is not desirable.

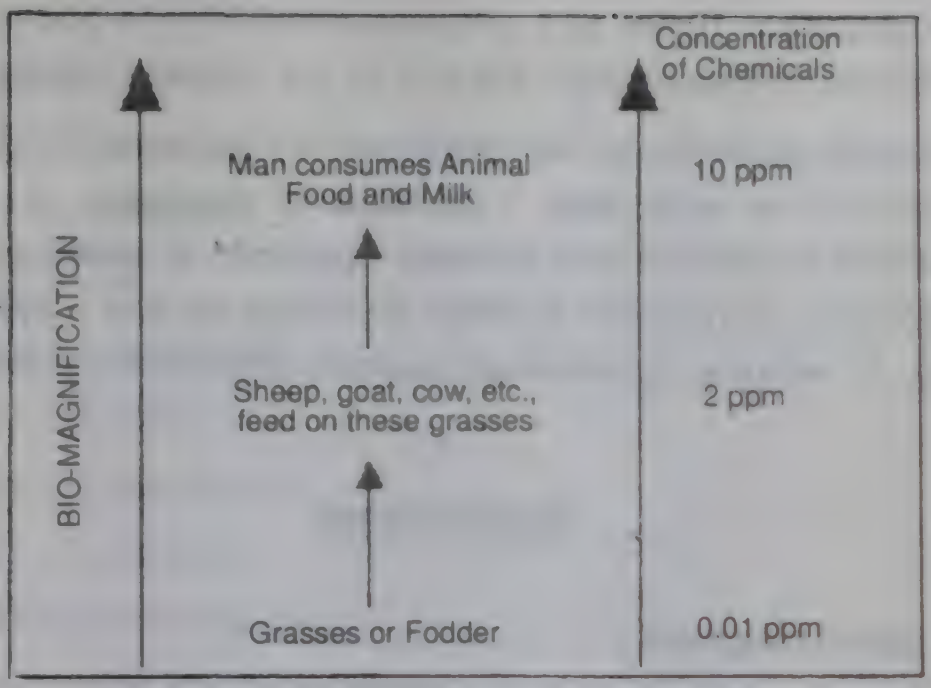

Fig. 1.7 : Bio-magnification
[Note the increase in the concentration of chemicals from grasses to man (values are approximate); ppm = parts per million]

Ecological Pyramids

These are graphic representations of trophic relationships and energy flow at different levels in an ecosystem. Such representations always take the shape of pyramids. The base of the pyramid is represented

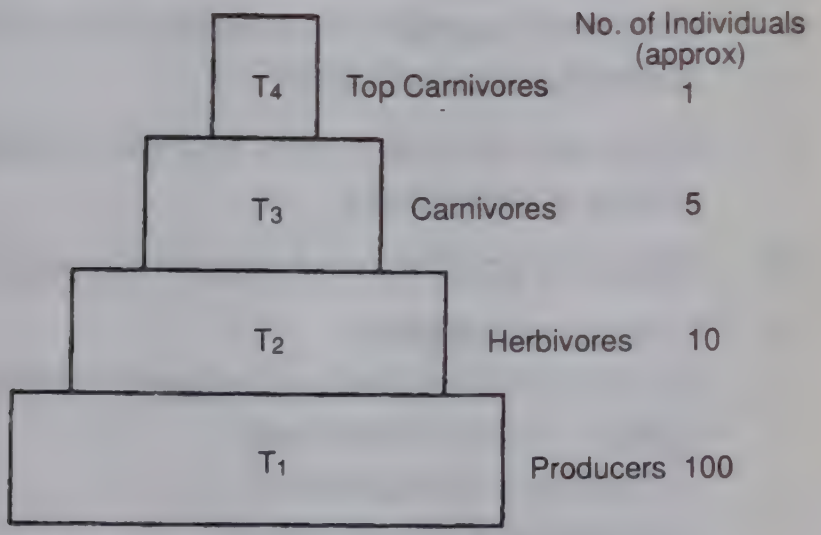

Fig. 1.8 : Ecological Pyramid of Numbers
[The heights of the recatangles remain constant while their widths vary. The area of each rectangle can also be interpreted in terms of energy or biomass.]

by the producers. There is a progressive tapering of trophic levels. Carnivorous animals occupy the top of the pyramid (figure 1.8).

Ecological pyramids can be constructed on the basis of the number of organisms at each level - **pyramid of numbers**; or may be represented in terms of total biomass - **pyramid of biomass** or may be graphically represented in terms of energy transfer - **pyramid of energy**. All eological pyramids are basically depictions of food chains.

QUESTIONS

1. Define biosphere.
2. Why is the biosphere considered the highest level of organization?
3. What are the main subdivisions of the biosphere?
4. Define biome. Name the two major types of biomes.
5. Name the terrestrial biomes you have studied.
6. Define ecosystem.
7. Distinguish between biome and ecosystem.
8. Distinguish between the physical characteristics of a tropical rain forest and a desert biome.
9. Name two dominant trees and two animals that live in the rain forests of Kanrnataka.
10. Where do you find rain forests in Karnataka?
11. Distinguish between:
    a) pyramid of number and pyramid of biomass.
    b) food chain and food web.
    c) herbivore and carnivore.
    d) producer and consumer.
    e) ecological balance and biological balance.
    f) biotic and abiotic component.

12. Define the following:

    a) food chain.

    b) environment.

    c) community.

    d) biome.

    e) phytoplankton.

    f) zooplankton.

    g) biomagnification.

    h) trophic levels.

13. Describe the following:

    a) tropical rain forest biome.

    b) open sea biome.

    c) food web.

    d) tropic levels in an ecosystem.

Chapter 2: ORGANISMS AND THEIR HABITATS

Introduction

We have studied about the environment in the first chapter. The specific kind of environment in which individuals of a species live is called the **habitat.** The word habitat literally means the dwelling or living place. Therefore, the habitat of an organism is a part of the total environment of any region. For example, the habitat of frogs is a pond, lake or stream. The habitat of elephants is the deciduous forests in the Western Ghats and the North-eastern regions of our country. The habitat of lion is the Gir forest in Gujarat. The habitat of the earthworm is the moist soil and that of the mosquitoes, the marshy areas.

The habitats of organisms should provide food, shelter and all the necessary requirements for the organisms to survive, breed and flourish. Any habitat would generally support more than one form of life. A stream for example is not inhabitated by frogs alone; several kinds of organism - algae and other water plants, fish and water insects - also live in it. Such groups of different species of plants and animals living in a habitat constitute the **biotic community.** They are bound together by many inter-relationships, of which the food chains are very important. The biotic communities are generally named after the most important or conspicuous plant species (example - grassland, forest etc., - grass is the dominant plant species in the grassland, trees are prominent in forests). The above are the biotic components of the habitat. The abiotic or physical components include the temperature, rainfall, light, atmospheric humidity and topography. The physical and the biotic features must be congenial to the life of organisms living in the habitat. For example, the biotic components and the physical conditions of the Gir forest are ideal for the Indian lion. The Indian lion cannot live in the Himalayan evergreens or the tropical rain forest of Brazil.

Microhabits (micro = small; habitat = living place)

Microhabitats are smaller habitats existing within a large general habitat **(macrohabitat).** The conditions in microhabitats are slightly different from those of the general habitat. Let us take a forest as an example of general habitat. Within the forest, the sides

of streams flowing in the forest, areas on the surface of rocks and beneath them, the surface of bark and inside it, the surface of leaves, etc., can be considered as microhabitats. The conditions in each of these microhabitats are quite different from the conditions prevalent in the forest. For instance, the crevices between rocks and areas underneath the rock are cooler and darker than elsewhere in the forest. Generally, smaller organisms such as insects, worms, liver worts and mosses, lichens, fungi, etc., are adapted to conditions in the respective microhabitat, while the larger organisms such as trees, climbers, elephants, tigers, deer, etc., are adapted to conditions in the general habitat.

Interdependence in Habitats

In a habitat, two different species may depend upon each other for their welfare, such as the egrets and the cattle. In a grassland habitat, the egret takes a ride on the cattle and eats the lice, ticks and other parasites on the skin of cattle. The cattle are also benefited in the process because they are freed of parasites. Similarly, there are many other instances of interdependence between plants and animals. There is also an interdependence and interaction between the abiotic and the biotic components in a habitat. For instance, more the number of trees in a region cooler it becomes and if the soil conditions are better, it can always support a large number of species.

Different types of Habitats

Though small variations of environmental factors create a variety of habitats, they are classified into two main types: (i) **Aquatic,** and (ii) **Terrestrial.**

In the aquatic habitat, water is the dwelling place of organisms. Dwelling places on land, the plains, mountains and deserts are the terrestrial habitats.

Some organisms live both in aquatic as well as terrestrial habitats (*eg.* frog, crocodile, etc.) Such organisms are called **amphibious** organisms. Some organisms in the terrestrial habitats make their dwelling on trees. These organisms are called **arboreal** organisms (*eg.* birds and monkeys).

Activity 2.1: Classifying organisms into their habitat

Go on a field trip and list the organisms of the locality or list the animals in a zoo you may have visited. Classify them into aquatic, terrestrial, amphibious and arboreal organisms.

Aquatic Habitats

Conditions for Life in Water

1. Oxygen is an important requirement for life in fresh water. It is poorly soluble in water. At 15 C only 7 mg dissolves in 1000 ml of water. In contrast, the same volume of air can hold as much as 209 mg of oxygen. Oxygen is uniformly diffused in the air. Whereas, in water its distribution is uneven. The bottom layers of a lake may not contain any oxygen at all due to the intense activity of the decay causing bacteria.

2. Being denser than air, water offers a lot of resistance to the movement of organisms. Therefore, aquatic organisms like fish, frogs and other animals have a boat shaped and streamlined body.

3. Water has the capability of making the organism buoyant. Water plants can attain large size without developing, supporting or mechanical tissues and float on the surface. Water animals like sharks and whales can bear bulky bodies. These organisms do not experience large fluctuations in temperature as the terrestrial organisms do. It is because water absorbs or loses heat very slowly.

4. The aquatic organisms must be equipped with suitable mechanisms for retaining the absorbed salts and to get rid of excess of water that diffuses into the cells.

The aquatic habitats comprise of (a) the fresh water habitat, and (b) the oceanic habitat.

a) Fresh Water Habitats

Fresh water habitats include ponds, lakes, streams and rivers. Fresh water generally contains a small quantity of dissolved salts (about 1/100th of the amount present in sea water).

Life in Fresh Water Habitats

When we visit a large pond or a lake we will see that each plant or animal species occupies a place that is best suited to it (see Chapter 1, figure 1.2). There are several kinds of water plants. Plants that grow in water are called **hydrophytes.** Along the borders or fringes of the pond moist or water logged areas are present. In the moist areas, plants like *Polygonum* and sedges are present. In the swampy, water-logged marshes plants like *Typha, Eleocharis* and some tall grasses grow.

In these marshy plants the root stalks or rhizomes are completely submerged, the remaining parts are above the level of water. These plants are called amphibious plants. In the shallow regions of the pond, there are some rooted plants with floating leaves. Eg, *Nymphaea* (water lily) and *Nelumbium* (lotus). These plants are rooted in the mud but have long petioles that enable the leaves to float on water. They have large air chambers (figure 2.1) which make them buoyant and help in proper aeration of the submerged parts. The stomata are present only on the upper surface of the leaves. Some filamentous algae grow attached to the floating plants.

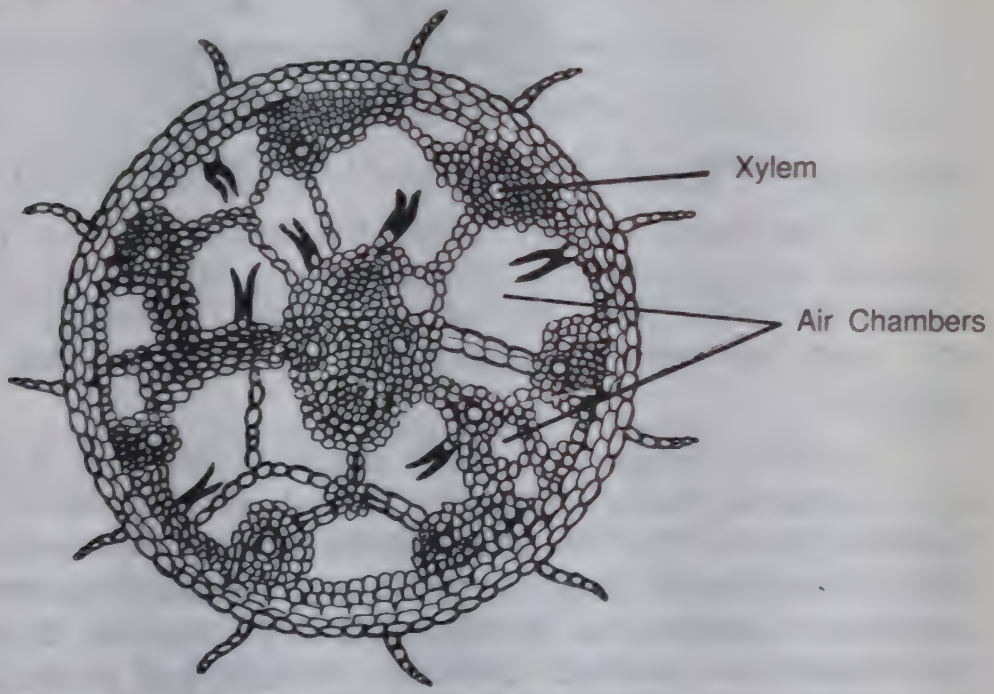

Figure 2.1: Section through Petiole of Nymphaea

Activity 2.2: Study of aquatic plants

Collect some water plants such as Hydrilla or water lily. Cut the stem of Hydrilla or the petiole of water lily. Observe large air

cavities. Observe the leaf surface of water lily. Why water drops do not stick to the surface?

Observe the above mentioned features in the other aquatic plants that you may collect. Can these plants grow in salt waters?

Some plants in the pond are completely submerged in water. They have long and slender stems as in *Hydrilla*, *Ceratophyllum* and *Potamogeton* or have tuberous stems as in *Vallisneria* (figure 2.2). The growth of these plants depends upon the availability of light below the surface of water.

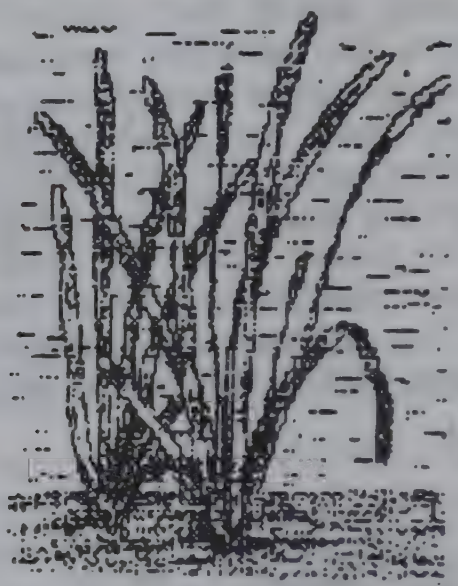

Figure 2.2: Vallisneria – an attached Hydrophyte

If the pond is very deep, the bottom of the pond either receives light of very low intensity or no light at all. On account of this, the green plants do not grow here. The saprophytic bacteria and fungi live here and carry out the decomposition of organic materials.

Another category of water plants is the free floating plants eg., *Eichhornia* (water hyacinth), *Lemna, Wolffia, Azolla, Pistia and Salvinia* (figure 2.3). The above plants float on the surface of water. They often grow in large numbers and completely cover the water surface. In addition to the above, a large number of free floating small plants and animals (plankton) consisting of algae, protozoans, crustaceans etc., live in the surface layer of water.

The animals life in the pond is always associated with plants. In the mud around the rooted plants, protozoans, Hydra, flat worms, snails, crustaceans and leeches are found. The insect larvae are abundantly seen in the shallow margins. Larger animals such as

fish, frogs and tortoises though found throughout the pond have a tendency to move near the shores where they get plenty of food.

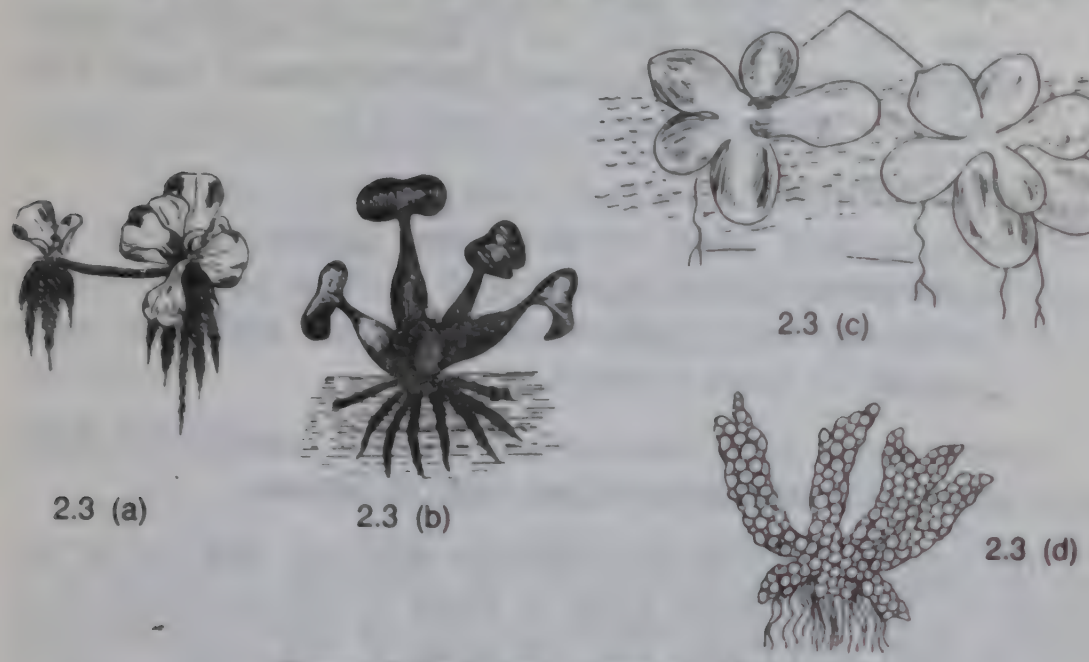

Figure 2.3: A few common Hydrophytes
[a – Pistia b – Eichhornia (water hyacint)
c – Lemna d – Azolla]

Adaptations of Hydrophytes

1. The roots are greatly reduced in size and lack root hairs.
2. The stem is delicate and thin due to the lack of mechanical tissues.
3. They generally multiply by the vegetative method.
4. The submerged leaves do not have cuticle.
5. The vascular tissues, particularly xylem, are poorly developed.
6. Presence of large number of air cavities is a characteristic feature. The air chambers store oxygen and carbon-dioxide and help in gaseous exchange. The air chambers also give buoyancy to the plants.
7. Chlorophyll is present in the epidermal cells also.
8. In the floating but rooted plants like Nymphaea, the stomata present only in the upper surface of the leaf. The coating of wax on leaves prevents the wetting or clogging of stomata.

Activity 2.3 : Study of fresh water algae in a saline medium

Take some fresh water algal filaments on a microslide. Put a drop of water and a cover glass on it. Observe under the microscope. What happens when you mount the filaments in a salt solution? Record your observations.

b) Oceanic Habitat

Oceans occupy about 71% of the earth's surface. The average depth of the sea is about 3800 m. The oceanic habitat is rich in life forms. The organisms are scattered over wide areas and are generally in large numbers.

Oceans have three well-defined regions, namely, a) **Continental shelf,** b) **continental slope,** and c) **abyss.**

The coastal land which continues into the sea for a few kilometers is the continental shelf. It forms a submerged platform around the main land mass. The sea water in this region is about 180 m deep. Beyond this, abruptly descending to about 1800 m is the continental slope. The abyss is the deep sea. The marginal parts of the sea, called the **littoral** region, experience tides twice a day. On account of this, the organisms that live in the shoreward region experience drastic changes in water levels, light and temperature.

Temperature fluctuation in the sea is much less than in fresh water bodies. The tropical seas have more marked variations in temperature than the temperate seas.

Considerable amount of light reaches the continental shelf. In the open sea, which has clear water, some light can penetratre upto a depth of 900 m. The marine vegetation which is mainly the kelp (algae) flourish only in the upper layers of water.

The sea water contains a high concentration of salts. The cell sap of plants and the body fluids of most marine invertebrates also have more or less the same concentration. This enables them to withstand high salt concentration in the habitat. Sea turtles and penguins have special salt glands that excrete salts in the from of droplets.

Life in the Sea : Shallow waters near the shore are rich in living organisms for the following reasons : i) Inorganic materials

are brought in by rivers and other sources, and ii) availability of light. Therefore, animals (herbivores) that directly depend on the plants occur in large numbers in this region.

Sea Plants : There are two kinds of sea plants : i) free floating plants, and ii) fixed or attached plants.

The free floating plants comprise the phytoplanktons which are the microscopic forms and the kelps that serve as food for fish and other animals. The fixed or attached plants comprise the algae that grow attached to rocks along the coast and a few flowering plants.

Sea Animals

The continental shelf and the sub surface layers of the oceans have a great diversity of animal life. They include protozoans, crustaceans, larvae of multicellular organisms and the young fish. These in turn are eaten by larger fishes, sharks sea birds, seals and whales. The floor of the continental shelf has animals like crabs, starfishes and molluscs. Commercial fishing is generally done in this region.

In the greater depths, animal life is not abundant. Animals that live in the abyss have to depend upon extrinsic sources of food as food is scare in this region. They live in a realm of darkness. Carnivorous and predatory deep sea fish live in this region. They are specially adapted for darkness, and can withstand the great pressure exerted by the enormous weight of the overlying water. Most of them have light producing organs.

Terrestrial Habitats

Terrestrial habitats, also called land habitats, provide a variety of combinations of physical factors. These habitats are discontinous because, the various physical barriers such as rivers, lakes and mountains limit each type of habitat. In the habitats on land there is adequate supply of oxygen and light, but the availability of water is variable. The abundance of solar radiation causes fluctuations in temperature on the land. But in the soils, at a depth of about 50cm or below, the temperature is more or less steady. On account of this, the organisms that live in burrows escape the extremes of temperature that are experienced on the surface during hot summers and cold winters.

Life in the Terrestrial Habitats

Depending upon the availability of water, terrestrial habitats are classified into two basic types :

1. **Mesic** – When the availability of water is moderate to good.

2. **Xeric** – When the availability of water is inadequate.

Plants that grow in the mesic habitats are called **mesophytes.** Most of the plants that grow in the tropical rain forests, moist deciduous forests and those that grow near tanks and rivers are mesophytes. In the forests of Karnataka the animals that are seen in these habitats are elephants, bisons, spotted deer and leopards.

Figure 2.4 Opuntia (prickly pear)
(Note the numerous spines on the plant body. They are modified leaves)

Plants that grow in the xeric habitats are called **Xerophytes.** These plants have suitable adaptations to conserve water. Similarly, animals that live in such habitats also have adaptations to conserve water. **Deserts** are typical examples of xeric habitats. Other places that receive lesser rainfall are also examples of xeric habitats. These are habitats of **physical drynes.** *i.e.*, dryness due to non-availability of water. There are other xeric habitats which experience **physiological dryness** (*eg.*, saline zones in the coasts and snow

zones in the mountains). In these area though water is abundantly available (in the form of saline water or in the form of snow) it cannot be absorbed by plants. On account of this, plants growing in these areas also exhibit xeromorphic characters (eg., mangroves in the coasts and pines in the Himalayas).

Nerium and prickly pear *(Opuntia)* are common examples of xerophytes (figure 2.4). Many cacti are also xerophytic. They have water storing succulent tissues and extensive root systems. In the cacti, leaves are modified into spines so as to check transpiration.

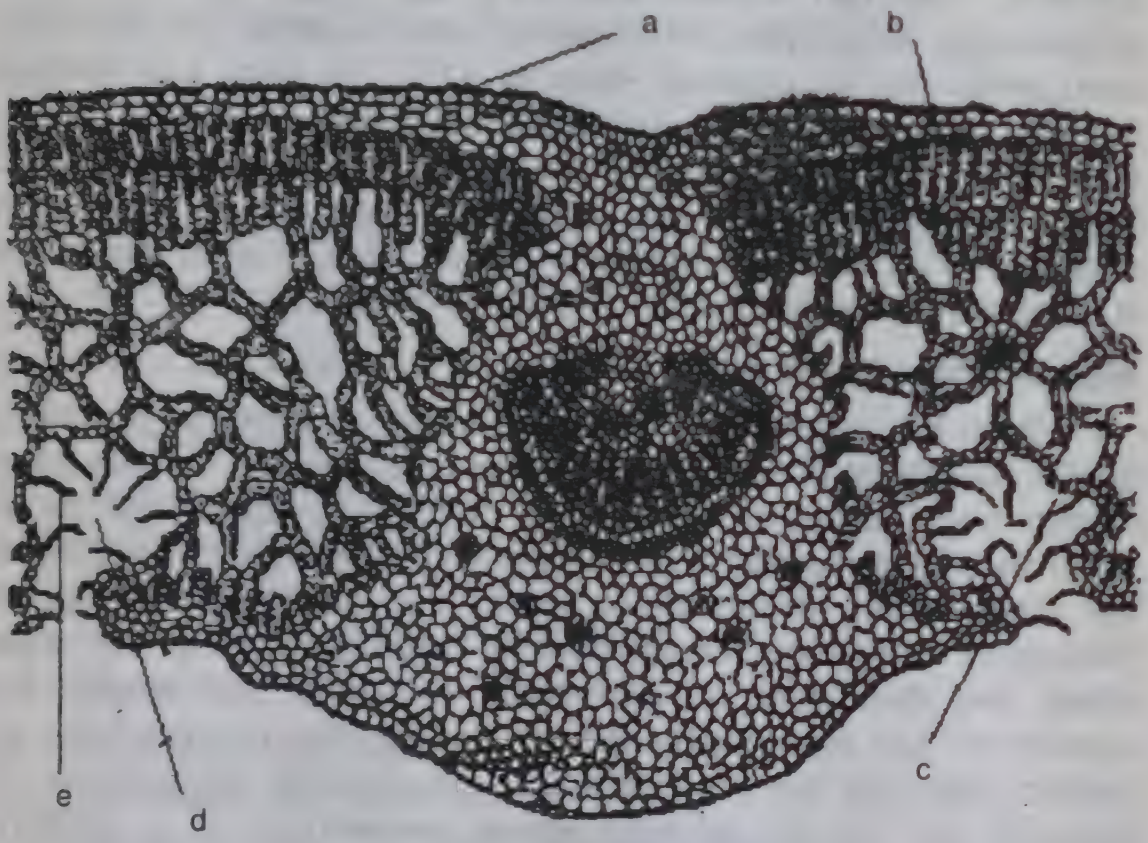

Figure 2.5 : Section through part of Nerium Leaf {Note the Xerophytic characteristics such as
(a) Thick Cuticle, (b) Mulitple Epidermis,
(c) Sunken Stoma, (d) Stomatal Chamber, and
(e) Epidermal Hairs}

In plants like *Nerium* there are adaptations in the anatomy of leaves to conserve water (figure 2.5). The leaves are stiff and leathery. They have a thick cuticle and sunken stomata (the stomata are located below the level of the leaf surface in deep cavities protected by hairs.)

Animal Life in Xeric Habitats

Unlike the plants, desert animals do not have major structural modifications for storing water. They depend on water sources that are available in the habitat such as oasis in deserts. The herbivorous animals may meet their water requirement by eating succulent plants. The predators get water that is present in the blood of their prey. Most animals are nocturnal and prowl during nights.

Camels and kangaroo rats are typical examples of desert animals. They can survive with very little water and also have physiological adaptations to conserve water. Camels do not sweat even when the temperatrue rises to 41°C. Its body can function normally even after it has lost water equivalent to 40% of its optimal quantity in the body. The kangaroo rat does not drink water. It eats only dry seeds. It has no sweat glands and it passes concentrated urine. Hence water loss is negligible. It uses water that is released during respiration (metabolic water).

Man manipulates the Habitats

Man has been the master manipulator of habitats. He makes drastic alterations of habitats to suit his requirements. He has transformed large areas of forests into plantations, agricultural lands, and has built dams and water reservoirs. He has been responsible for large scale desertification and creation of xeric habitats throughout the world. Destruction of vegetation along the water sheds and river bank is responsible for floods, soil erosion and creation of bad and infertile lands. The activities of man have extended even into the Antarctica. Though scientific explorations are essential one has to act with utmost restraint so as to preserve the natural balance that exists in habitats.

QUESTIONS

1. Define habitat.
2. What do the habitats provide?
3. What is a biotic community?
4. Define microhabitat? Give an example.
5. What are the major habitats?

6. Differentiate between aquatic and terrestrial habitats.
7. Mention two aquatic plants found in a lake.
8. What are hydrophytes? Mention two important modifications seen in a hydrophyte.
9. Name two xerophytic plants and mention two modifications in them.
10. What are the types of hydrophytes seen in fresh water habitats?
11. Why is xylem poorly developed in hydrophyte?
12. How is the ocean categorized into zones? Name them.
13. Where is commercial fishing done in an ocean? Why?
14. Why is the abyss called the zone of darkness?
15. Name two abyss dwellers.
16. What are kelps? Where do they grow?
17. What are mangroves? Where do they grow?
18. Explain the following :
    a) interdependence
    b) adaptation.
    c) conditions of life in the ocean.
    d) continental shelf.
19. Distinguish between :
    a) habitat and microhabitat.
    b) continental shelf and continental slope.
    c) floating and submerged plants.
20. Define the following :
    a) xerophyte.
    b) physiological dryness.
    c) metabolic water.
    d) nocturnal animals.

Chapter 3 : BIOGEOCHEMICAL CYCLES

Introduction

Living organisms require several nutrients some in large and others in small quantities. Elements like carbon, oxygen, nitrogen, hydrogen, phosphorus, potassium, magnesium, calcium and sulphur which are required in large quantites are called **macronutrients.** Others like iron, copper, zinc, boron, sodium and cobalt are required in small quantities and are therefore called **micronutrients.** In ecosystems, movement of all these elements is cyclic, passing through the biotic and abiotic components. Even at the level of bioshpere, we can trace the cyclic movement of all these nutrients. These cycles operating in nature, called biogeochemical cycle, involve the cyclic passage of the above elements between the living and the non-living components. We have already learnt that in ecosystems energy is lost in the form of heat and its movement is always unidirectional. But the elements (nutrients) are generally not lost from the ecosystem or biosphere. They are always returned to the nutrient pool of nature (soil, water) by the activity of decomposers. The producers reabsorb these nutrients and thus the cyclic movement continues eternally.

Biogeochemical cycles are classified into two groups:

1. **Gaseous cycles** - circulation of elements that are essentially in gaseous form (*eg.*, carbon, oxygen, hydrogen and nitrogen cycles).
2. **Sedimentary cycle** - circulation of elements that are essentially earth bound, with only a small portion getting into the air. (*eg.*, phosphorus, sulphur and calcium cycles).

1. The Carbon Cycle

Atmosphere is the reservoir of gaseous carbon in the form of carbon dioxide (figure 3.1). Carbon dioxide is also present in water in dissolved state. Green plants utilize the carbon dioxide for photosynthesis. Once carbohydrates are synthesised, they travel as food to the various trophic levels. Finally carbon returns to the atmosphere and water bodies as carbon dioxide through the activities of decomposers.

Millions of years ago some plants escaped decay and were converted into fossil carbon fuels such as coal, oil and gas. Carbon is returned to the atomosphere through combustion of these fuels. Plants and animals release carbon dioxide as a byproduct of respiration. Volcanic eruptions also release large amounts of carbon dioxide into the environment. The element carbon, thus, passes from the nonliving world to the living world and back again to the abiotic world. There is also a continuous exchange of carbon dioxide between the atmosphere and the water bodies.

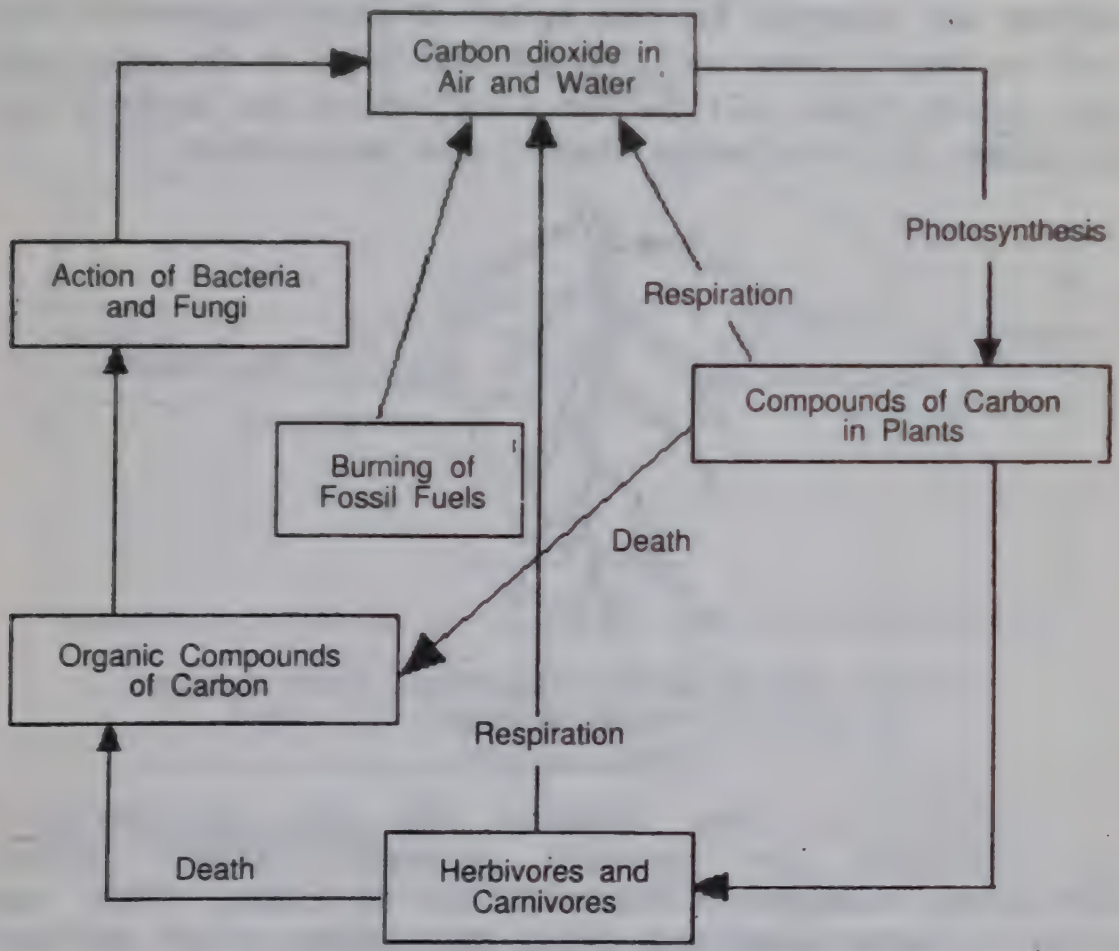

Figure 3.1: Schematic representation of the Carbon Cycle

2. The Nitrogen Cycle

Nitrogen is an essential component of amino acids, proteins and nucleic acids that form a significant portion of living organisms. It occurs abundantly in the atmosphere in gaseous state (about 78%). The atmosphereic nitrogen cannot be utilised by most living organisms as it is in molecular form. It has to be converted into a usable form (nitrates) before it can be absorbed by green plants.

Only blue-green algae, some bacteria and leguminous plants can absorb nitrogen in molecular form. While blue green algae and some bacteria can absorb molecular nitrogen directly, the leguminous plants absorb this form of nitrogen through a bacterium called Rhizobium, present in root nodules. The process of absorption of free nitrogen of the atmosphere by organisms is called **biological nitrogen fixation.** Non-leguminous plants like Alnus and Zinko also fix atmospheric Nitrogen. Forms compounds of nitrogen used by plants.

Activity 3.1: Examine the root system of some leguminous plants such as beans, peas, etc. You will find bulge in the roots called root nodules (figure 3.2). Section a root nodule and observe under the power of a microscope. Record your observations.

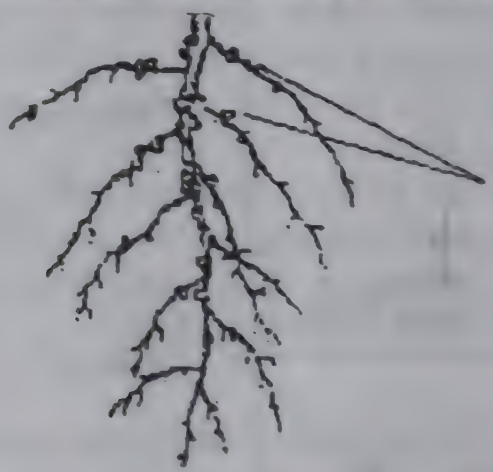

Figure 3.2: Roots of a Leguminous Plant showing Root Nodules

Nitrogen is also released into the atmosphere by physicochemical and industrial processes. During lightning, atmospheric nitrogen is converted to its oxides. Rain water dissolves these oxides and brings them down to soil. Oxides of nitrogen are also released through industrial processes and volcanic eruptions (figure 3.3).

Plants absorb nitrogen in the form of nitrates and ammonium ions from the soil. When plants and animals die, the complex nitrogenous compounds (proteins, amino acids and nucleic acids) in their remains are converted into ammonium ions. This proces is called **ammonification.** The ammonium ions in the soil further get converted into nitrates by the action of soil bacteria, *Nitrosomonas* and Nitrobacter. This process is called **nitrification.** Another set of bacteria called the denitrifying bacteria, eg. *Pseudomonas*, convert

the nitrates in the soil to molecular nitrogen which escapes into the atmosphere. This process is called denitrification. Use of nitrogenous fertilizers such as urea, also contribute to soil nitrogen.

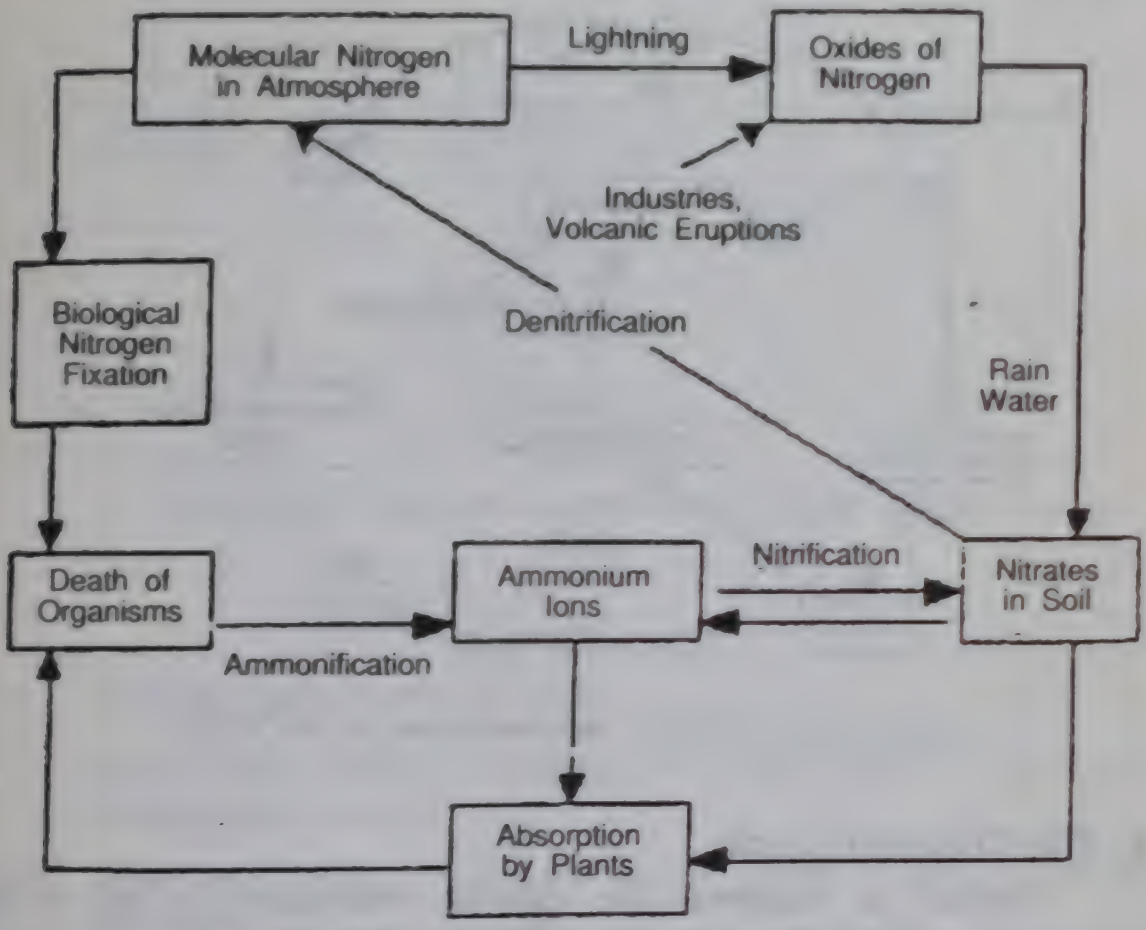

Figure 3.3: Schematic representation of the Nitrogen Cycle

3. The Water Cycle

Water cycle is also known as the hydrological cycle. Water circulates in the environment and is of prime importance to life. In water, hydrogen is the main element that circulates while water moves as a compound. Water cycle ensures the availability of fresh water to the organisms. Rainfall and snow are the sources of water to the soil and water bodies. Plants absorb water from the soil. Animals procure water through food and drink. Through evaporation from water bodies and transpiration from plants, water vapour ecapes into the atmosphere. When the temperature and pressure drop, the water vapour in the clouds condenses into different forms of precipitation such as rain and snow (figure 3.4). Most of the

rain water falls on the sea and is of little use to man. Only a small percentage of rain water falls on land and this is the life sustaining fresh water for all land organisms.

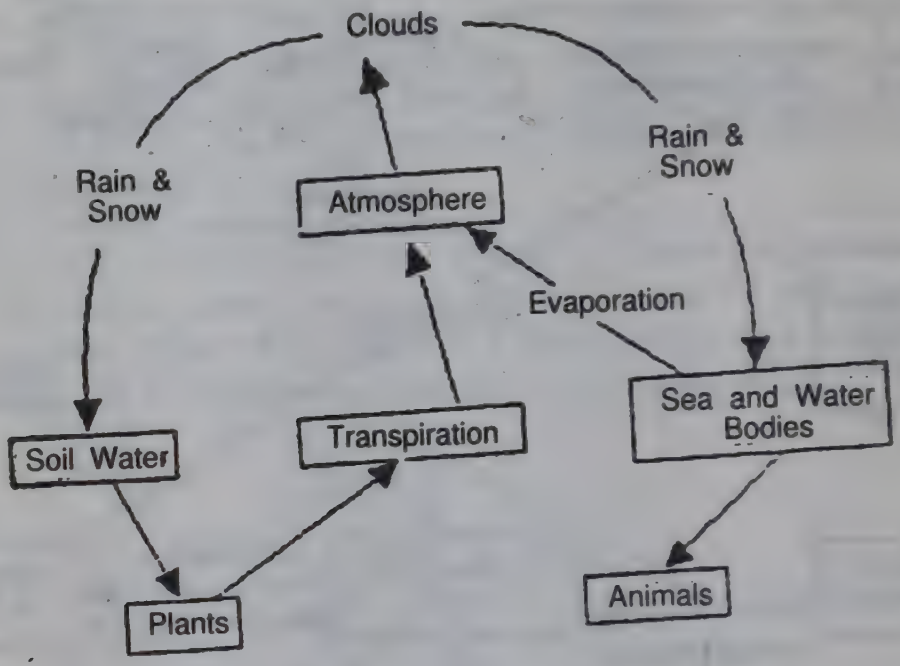

Figure 3.4: Schematic representation of the Water Cycle

4. The Oxygen Cycle

Oxygen is essential for cellular respiration in all living organisms. Organisms can live without water and food for some time, but not without oxygen. Where do organisms get their oxygen supply? Oxygen is abundantly found in gaseous form in the atmosphere (21% of gaeous matter is oxygen). In a dissolved state with water, it is also found in water bodies. All the terrestrial organisms get their oxygen from the atmosphere and most of the acquatic organisms depend on the oxygen dissolved in water. Burning of coal, wood and fossil fuels also use atmospheric oxygen (figure 3.5).

How is oxygen replenished? This is done largely by plants. As you have already learnt, oxygen is formed as a byproduct during photosynthesis. This oxygen escapes from the plants and restores the oxygen balance in the atmosphere. Similarly, aquatic plants and direct diffusion of atmospheric oxygen restore the oxygen balance in the water bodies. Carbon dioxide and water are the commonly occuring compounds containing oxygen circulating between living organisms and the atmosphere.

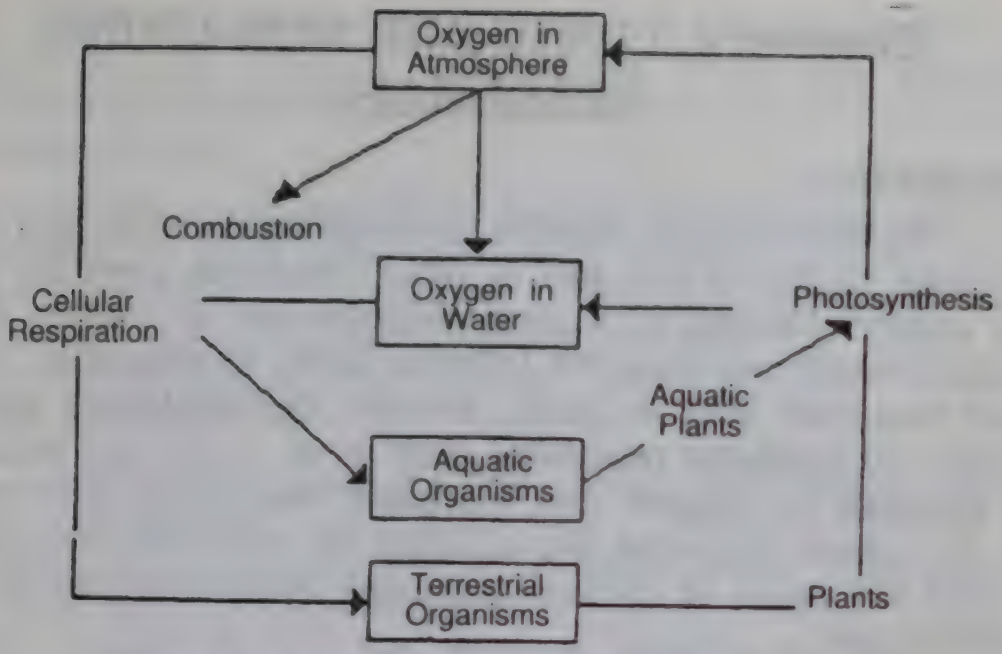

Figure 3.5: Schematic representation of the Oxygen Cycle

QUESTIONS

1. Define biogeochemical cycle.
2. Differentiate between macro and micro nutrients. Give two examples for each.
3. What are gaseous and sedimentary cycles? Give an example for each.
4. Give a schematic representation of carbon or nitrogen or water cycle in nature.
5. How are fossil fuels formed?
6. Name the nitrogen containing compounds in our body.
7. Name the organisms which can directly take molecular nitrogen. What is the process called?
8. What is nitrification? Where is it taking place?
9. Name the organisms that bring about nitrification.
10. Define denitrification.
11. How has man intervened in the nitrogen cycle?
12. How is the oxygen balance maintained in the atmosphere?
13. Why is oxygen very essential for living organisms?
14. Can you call cellular respiration a type of combustion? Give reasons.

Chapter 4. LIVING AND NON-LIVING RESOURCES

Introduction

The term resource includes all those things which are useful to human society in one way or other. Resource therefore refers to a source of supply or support generally held in reserve. In the biological world, we have the following types of resources: (i) **Organic resources** such as plants, animals, microorganisms and fossil fuels, (ii) **Inorganic resources** such as air, water and ores, and (iii) **Mixtures of organic and inorganic resources** such as the soil. The above resources are essential for supporting the life and to meet the needs of human community. Resources can also be classified into:

1. Renewable resources: These are also called inexhaustible resources. They have the capability to replenish themselves and can be constantly cycled in the biosphere. Some examples are living organisms (forests, wild life and fish), soil and water. However the rate at which their renewal occurs varies and is dependent on several other factors.

2. Non-renewable resources: Resources that are not recycled or replaced are called non-renewable resources or exhaustible resources. Examples of non-renewable resources are fossil fuels like coal and petroleum and several minerals.

Activity 4.1: Make a list of the sources of energy in your home, industries and automibiles in your area. Classify them into renewable and non-renewable resources.

Living Resources

Plants, animals, and microorganisms constitute the living resources. **Plants** satisfy a range of human needs such as food, shelter, medicine, paper, oils, rubber and raw materials for industries. They also provide timber and fibres. The sum total of plant species that grow under common climatic conditions in a particular area constitute the **vegetation** of that area.

Forests are the richest resources for mankind. On an average, plants produce 380 thousand million tonnes of dry biomass annually.

Most of this resource, especially the products of land vegetation, are used by man. Nature offers vast potential for harnessing wild plants from forests and oceans for food, medicine and other uses.

Of the living resources, forests are biological communities dominated by trees along with shrubs and other woody vegetation. Forests provide useful materials to man like timber, raw materials for paper, canes, bamboos, honey, essential oils, tannins, gums, ivory and medicines. They play an important role in the economy of the country.

Forests also protect the environment. They prevent soil erosion caused by wind and water. They have a favourable influence on the climate. They utilize large amount of carbon dioxide for photosynthesis and thus purify the environment. They are the natural habitats for a variety of wild life. For man, they are areas of recreation and for a biologist, they are nature's laboratories.

Plant resources are renewable but the unscrupulous activities of man are creating some special problems. Man has improved the quality of only those plant species that are useful to him such as crop plants, fruits and vegetables. Through extensive research he has created new varieties some of which are high yielding and disease resistant. He has thus assured their survival on our planet. While such activities of man are nature friendly, he has also inflicted irrepairable damage to nature by his banful activities such as deforestation, converting forest land into plantations, agricultural fields, setting up of industrial plants and causing various kinds of pollution. As a result of these, many plant and animal species (mostly those that are of little use to man) have become endangered due to disturbances in their habitats. As these plants are of little use to mankind, attempts to conserve such plants are almost none. Some of these plants have even become extinct.

All over the world, the forest cover is being dangerously reduced due to increasing human population, human needs and rapid industrialization. In India, as per a recent estimate, the forest cover is only about 20 percent of the total land area. For a healthy environment and a prosperous national economy, the forest area should be maintained at atleast 33% of the total land area of that country. Deforestation and overgrazing have already caused extensive soil erosion, loss of precious wild life and has induced desertification. These will ultimately affect the environment. Therefore, it is necessary to conserve this living resource.

Conservation of forests has been undertaken seriously in India. Exclusive reserve forest areas have been identified where human activity and interference is forbidden. The following are the other measures taken to conserve forests.

1. In the reserve forests, tree felling has been completely stopped.
2. Tree planting programmes under afforestation schemes have been undertaken in forests.
3. Social forestry, farm forestry and community forestry schemes are encouraged.

The following measures would also help in preserving the present forest cover:(a) The use of firewood and charcoal as sources of energy has to be discouraged. Alternative source of energy may be provided to the common man at a cheaper cost. This would reduce felling of trees in forests. (b) Modern method of forest management like pest management, use of fertilizers, irrigation facilities and tissue culture techniques for propagation of important species (including threatened and endangered species) are to be employed.

Animals provide us food, fur, leather and manure. Animals are the consumers and they have many vital roles in ecosystems. They help in pollination of flowers and dispersal of fruits and seeds. Domestic and pet animals like cattle, horse and dog have been in the service of mankind for quite sometime.

Endangered Species

Endangered species are organisms that are present in such small number that they are in immediate danger of becoming extinct. Man has been the cause for the extinction of many species of plants and animals. The International Union of Conservation of nature and Natural resources (IUCN) has identified certain endangered species of plants and animals for immediate conservation. This identification is based on:

1. The present and past numbers of the species.
2. Nature and quality of the habitat of that species.
3. The value of the species.

In our country, some of the animals facing the danger of extinction are the Indian Lion, Rhinoceros and the Indian bustard.

Similarly, a large number of plant species are becoming rare and are facing the threat of extinction. Therefore, conservation of wild life is an immediate and top priority task for the country.

Conservation of wild life: Wild life includes all uncultivated and non-domesticated organisms in their natural habitats. India has a rich heritage of wild life. The conservation of wild life prevents extinction of valuable species of plants and animals and also helps in preserving the biodiversity. The Government of India has taken up the following measures to conserve wild life:

1. Prevention of human activities of all kinds in the reserve forest areas.
2. Improving the natural habitats of important wild species of plants and animals.
3. Breeding of wild animals in captivity and releasing them in new natural habitats.
4. Creating wild life park (eg., Bandipur and Nagarhole wild-life park).
5. Enforcing strict legislation against cutting trees, hunting and poaching of animals.

Microorganisms: Eventhough Microorganisms cause diseases in man they are also great friends to humanity. Human digestive system has a larger number of friendly microorganisms (eg. some protozoan and bacteria). When man learnt preparing yogurt (curds), butter and wine, it was the beginning of biotechnology (use of living organisms or substances obtained from them in industrial processes). Microorganisms are extensively used in the manufacture of alcohol, methane, vitamins, antibiotics, enzymes, organic acids and several other products of human requirement. They can also be used in treating industrial waste water and oil slicks in the sea.

Objective of Conserving Living Resources

Conservation of living resources is a complex operation because, it is not only concerned with living organisms like plants and animals but also with the non-living environment on which they depend. Conservation of living resource has the following main objectives.

1. To ensure sustainable utilization of species of ecosystems that support human societies and our industries.

2. To preserve the biodiversity (this includes the preservation of genetic diversity in the organisms of the world).

Non-living Resources

Land Resource: Land is a major constituent of the lithosphere and is the only source of minerals to plants. Only about 30% of the total earth's surface is land area. Of this, Antarctica, areas of north pole, deserts and highly elevated mountain ranges are not suitable for human inhabitation. Therefore, only a small portion of the land surface is available for human inhabitation. If we take the present human population and the available land into consideration, the per capita availability of land is only about 6 acres. If the population doubles in the next 30 years the available land will be only 3 acres per head. In terms of a quality environment, this is too low an average because within this land, every individual has to plan all his requirements. The pressure on land is thus increasing at an alarming rate. This has also led to encroachment into forest areas, deforestation and other ecologically undesirable acts.

Land, therefore, is an important resource that has to be conserved. Due to centuries of bad and unscientific land use, man has exposed the land to soil erosion, deforestation, over grazing and over cultivation of crops. These have exposed the fertile superficial soil to the fury of water and wind creating bad and infertile lands. Therefore, soil conservation is now the need of the day.

Soil Conservation: Soil is produced by a slow process of weathering of rocks. It has been calculated that it takes 500 to 1500 years to build an inch of top soil from rocks. but a single flood or a dust storm can remove all the unprotected top soil within minutes. Top soil is very important for plant growth because it is the reservoir of minerals, organic matter, water and soil organisms. If the top soil is removed by erosion, the sub soil which is stony and rocky is infertile and unsuitable for plant growth. Further, if soil erosion is not controlled, deserts start expanding. This process is called **desertification.** As a result, many fertile regions of the world will be converted into waste lands. Therefore, the top soil should be protected from loss. Such an act of protecting the top soil is called **soil conservation.**

Figure 4.1: Effects of Soil Erosion
[Note the formation of Rills and Gullies and the Exposed Root System of Trees]

Bare soils without any vegetation are easily eroded by wind and water. In the coastal areas and in deserts, fast moving wind currents lift the dry soil particles and carry them to far off places creating sand dunes. These dunes are temporary and can move to other places depending upon the velocity and direction of wind. Thus the deserts can move. Many deserts in the world like Sahara in North Africa and Thar in India encroach the neighbouring territories due to their shifting sand dunes. Similarly when the rain water flows down a steep slope it removes unprotected top soil. Rapid flow of water during monsoons causes floods which also wash away the top soil faster, leaving behind rills and gullies. It also exposes the roots of plants (figure 4.1) As a result, plants get easily uprooted by a gust of wind or rushing waters. On the other hand, if vegetation covers the land, top soil is prevented from being washed away. The interlocking and interlacing systems of roots of plants bind the soil particles and hold them together. It also allows percolation of water to deeper layers of the earth's crust thus enriching the underground water table. Part of the water is retained on the surface by the soil organic matter, thus reducing the surface flow. The aerial parts of plants give an umbrella like protection to the soil surface from the splashing rain drops.

Figure 4.2: Contour Tilling

Figure 4.3: Tree Belt

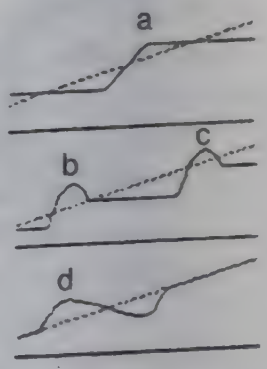

Figure 4.4: Terraces

[Note In figure 4.4, the dotted lines indicate the original ground surface. a to d are terraces built with suitable materials].

Unchecked soil erosion, removal o' surface soil would result in destruction of landscape, silting of dams, loss of soil fertility and decrease in crop yields. The following are some of the methods to prevent soil erosion:

1. Improving the vegetational cover by growing grasses which cover the top soil or by planting suitable trees through reforestation schemes. The roots of plants bind the top soil and keep the soil in place.

2. By ploughing at right angles to the direction of the slope called contour tilling (figure 4.2).

3. By establishing contour bunds and terraces (figure 4.4) in the slopes.

4. By growing tree belts or shelter belts (figure 4.3) that give protection against winds of high velocity. This reduces erosion by wind.

Mineral Resources: Mineral resources are non-renewable. Their deposits are limited in the world. Mineral resources include both metallic and non-metallic minerals (see also Part I, Chapter 16). Some of them are essential nutrients for plants. Minerals enter the body of animals through the food chains.

Man uses a variety of minerals in large quantities for his industrial activities. Some of the metallic minerals that are in great demand are iron, copper, lead, zinc, aluminium, gold and chromium. Non-metallic minerals include sulphur, phosphorus, asbestos and a few others.

Due to over exploitation, some of the minerals may become short of supply in the coming decades, eg. mercury, copper, gold and silver. Therefore, it is time to control wasteful and injudicious use of minerals. Recycling and reuse are to be adopted. Substitutes for exhaustible minerals are to be used.

Energy Resources: Modern man needs energy for various purposes like agriculture, industry, transport, communication, home appliances and for defence. In the developed countries, the per capita consumption of energy is around 2,50,000 kcal. In the under developed countries it is around 12,000 kcal.

The main sources of energy are fossil fuels (coal, petroleum and natural gas). Wind energy, wave energy and solar energy are not yet commercially harnessed. (See also part I, Chapter 2)

Nuclear energy is said to be a clean and cheap source of energy. But the nuclear power plants produce large amounts of waste heat and waste water. This is a serious ecological concern. Radioactive wastes can move in the food chains and cause serious disorders in man. (See also Part I, Chapter 9)

Water Resources: Water is a vital constituent of the biological world. Man needs water for agriculture, industrial operations and other purpose. It has a strong influence in regulating the climate. World's water resources form a single entity. A critical estimate of world's total water resources has shown that it has about

1.46×10^9 cubic km of water. 93% of the above water is in the oceans. 4% is in the earth's crust. 2.5% is in the glaciers and polar ice caps. Only about 0.5% is in fresh water lakes, rivers and as atmospheric moisture. As the available fresh water for all the living organisms is inadequate compared to their demands, it is necessary to conserve fresh water resources and also control its pollution (see also, Part I, Chapter 16).

QUESTIONS

1. What is a natural resource? Write any one of the Classifications of natural resources.
2. Differentiate between renewable and non-renewable resources. Give two examples each.
3. Mention five important plant resources of forests of Karnataka.
4. Are micro-organisms a type of natural resource? Justify your answer.
5. Describe how the activities of man have brought about changes in the living resources.
6. Suggest a few methods for conserving plant resources.
7. Distinguish between:
   a) contour tilling and tree belt.
   b) afforestation and deforestation.
8. Give examples for the following:
   a) wild life parks in Karnataka.
   b) endangered animals.
   c) renewable resources.
   d) methods of soil conservation.
   e) alternate source of energy.
9. Answer the following briefly:
   a) objectives of conserving living resources.
   b) importance of the land resource.
   c) plant biomass.
   d) energy resources in India.
   e) objectives of reserve forests.
10. Define the following:
    a) biotechnology b) IUCN c) desertification
    d) vegetation e) soil erosion
11. Distinguish between exhaustible and inexhaustible resources. Give two examples each.

Chapter 5: POLLUTION OF THE ENVIRONMENT

Introduction:

Pollution is defined as an undesirable change in the physical, chemical or biological characteristics of air, water and land that may harmfully affect living organisms, industrial processes or raw materials.

In the modern age, industrial activities of man are producing a large number of useful materials. At the same time, they are discharging into our environment large quantities of wastes (smoke, chemicals, etc.) which are of a harmful nature to all the living organisms. Such substances are called environmental pollutants. Unscientific management of all such pollutants leads to pollution of the environment. On account of this, the air we breathe, the water we drink and the soil in which we grow our food crops - all become contaminated.

Environmental pollution can be variously classified. The most acceptable classification is the one based on the medium that is polluted and the substance or agent that causes pollution. Accordingly, environmental pollution can be classified into the following five types:

1. Air pollution
2. Water pollution
3. Soil pollution
4. Radioactive pollution
5. Noise pollution

1. Air pollution

Industries, automobiles, and modern agricultural operations release a large number of chemicals, smoke, dust and poisonous gases into the atmosphere. Volcanoes and forest fires also contribute to air pollution.

Different types of industries contribute different types of toxic pollutants. Automobiles discharge compounds like carbon dioxide, carbon monoxide, hydrocarbons, oxides of nitrogen and others. Carbon monoxide is highly toxic. It impairs respiration. Some of the toxic gases undergo photochemical reactions with oxides of nitrogen in the atmosphere to generate photochemical smog. Smog is a combination of smoke and fog. It has toxic effects on plants, animals and human beings. Smog formation is common in many industrial cities like Bombay, Calcutta, Delhi and Bangalore.

When fossil fuels like coal are burnt, oxides of sulphur (sulphur dioxide and trioxide) are produced. These gases when released into the atmosphere react with rain water to form acids which come down as acid rains (figure 5.1). Acid rains are common over several European and Scandinavian countries. They have caused extensive damage to plants, animals and their natural habitats, historical monuments and have also polluted water bodies.

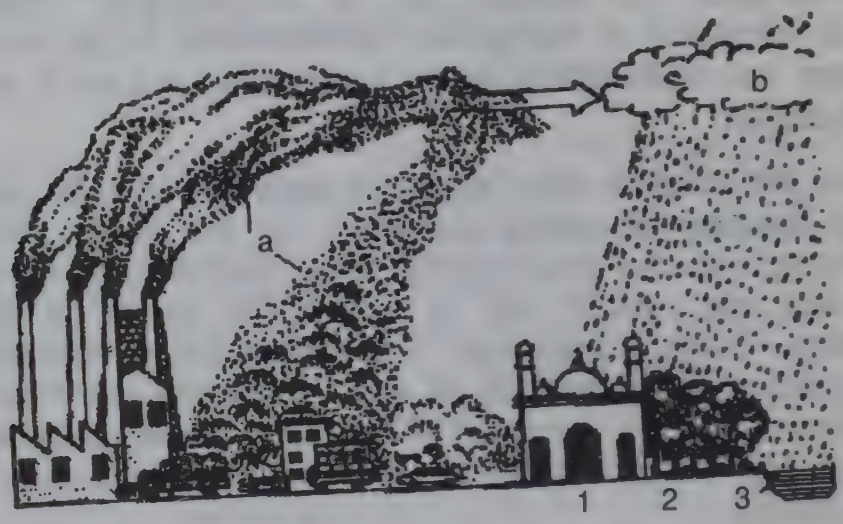

Figure 5.1: Acid Rain

[a – fumes from factories and automobiles containing sulphur dioxide and oxides of nitrogen. b – these gases dissolve in water vapour during cloud formation. c – acid rain falling on 1. monuments, 2. vegetation and 3. water bodies]

Effects of Air pollution: The following are the important effects of air pollution:

A. Effect on human health : (a) Polluted air causes respiratory disorders such as bronchitis and allergies. The Bhopal gas tragedy of 1984 in which a poisionous gas, methyl isocyanate, was the pollutant, claimed several thousands of human and many of those who escaped death are severely disabled. (b) Smog is a killer precipitation. It can cause bronchial afflictions that may lead to death. (c) Excess hydrocarbons in the atmosphere are reported to cause cancer. (d) Carbon monoxide combines with haemoglobin and impedes oxygen transport in the blood.

B. Effects on vegetation : (a) Acid rains can damage or destroy forest trees, kill or damage most of the flora and fauna of aquatic bodies and increase the acidity of soils. (b) Smog alters the normal physiology of plants. (c) Air pollutants inhibit the growth of lichens on trees. Infact, lichens serve as valuable indicators of air pollution.

C. Effects on buildings, monuments and materials: (a) Acid rains and smog can damage historical monuments. The world famous Taj mahal is an unfortunate victim of air pollution. (b) One of the air pollutants, ozone, can oxidise rubber goods.

D. Effects on Climate : (a) The climatic factors are too complex to understand. It has been observed that carbon dioxide levels in the atmosphere affect the temperature on the earth. In the recent year its level has increased due to the excessive use of fossil fuels and large scale destruction of forests. This has lead to a rise in the global temperature. This phenomenon is similar to that taking place inside glass houses where plants are grown. Hence this phenomenon is called the **greenhouse effect.** If this rise in temperature is more than 2 or 3 degrees, it may lead to the melting of polar ice caps and glaciers causing rise in the level of water in the oceans. This may submerge some coastal cities like Bombay and London, and countries like Maldives and Bangla Desput frame-fx... ratum of the earth's atmosphere contains a layer of ozone. This layer acts like a natural filter and prevents excessive irradiations of the Sun, such as ultraviolet rays, from reaching the earth. Air polluntants such as chloro fluorocarbvp-fx.FC) from refrigerators and aerosol sprays are depleting the ozone layer. As a result, high doses of irradiatput fill-fx... ^F and are believed to cause skin cancer and mutations.

Control of Air pollution : Air pollution can be controlled by a thorough understanding of its causes, strict monitoring and by enforcement of stringent environmental laws. The government of India has promulgated the Pollution Control Act under the provisions of which Pollution Control Boards in the states and the centre have been set up. National Environmental Engineering Research Institute (NEERI), Nagpur has conducted a nation–wide survey of air pollution and found that Ahmedabad, Bombay, Calcutta, New Delhi, Kanpur and Madras are severely polluted. As a remedy, it has suggested that the pollutants can be separated from harmful gases or they can be converted into harmless forms by chemical neutralization. Control at the source appears to be more effective than a later rectification after the pollutants are released into the atmosphere.

2. Water Pollution

Water pollution refers to all types of aquatic contamination due to addition of sewage and toxic chemicals present in agricultural and industrial wastes. Water pollution adversely affects the

quality of water and disturbs the natural balance of aquatic ecosystems. It also causes serious public health problems.

Causes of Water Pollution : Water pollution is mainly due to the following causes :

i) **Industrial Wastes :** Various kinds of industries like paper mills, sugar factories, iron and steel industries, food processing industires, fertilizer factories, textile mill, electroplating industries and chemical plants release waste waters into the neighbouring water bodies like rivers and lakes. These waste waters often contain toxic materials like cadmium, lead, chromium, mercury, fluorine, acids and alkalies.

ii) **Unscientific management of sewage:** Sewage contains human and animal excreta in addition to food residues, detergents and other wastes. It is rich in disease causing bacteria and organic substances. Sewage from big cities like Bombay and Bangalore flows out like rivers. Addition of sewage into natural water bodies seriously affects the quality of water.

iii) **Agricultural wastes:** These wastes contain residues of fertilizers and pesticides which can be very easily carried into a nearby body of water.

iv) **Addition of superheated water:** Addition of superheated water from some industries and nuclear power plants results in thermal pollution.

v) **Addition of wastes** from refineries and oil into seas and oceans, causes marine pollution which is detrimental to mairne life.

In our country, important rivers such as the Ganga suffer from all the above types of fresh water pollution.

Effects of water pollution: (a) Industrial pollutants like mercury, chromium, cadmium and lead are poisonous. They are also capable of moving in the food chains and cause diseases in man. In India high fish mortality is common in such rivers. Mercury is a byproduct of power plants. It is known to cause **minamata** disease (first reported from Japan.) Methyl mercury can cause initial numbness of limbs, lips and tongue. Finally, it leads to impairment of motor control, deafness, blurring of vision, cellular degeneration in the brain, spasticity, coma and death. (b)High concentrations of nitrates and phosphates in the sewage stimulate excessive plant growth in lakes and rivers due to **eutrophication** (enrichment of

water by phosphates and nitrates) of water bodies. (c) Organochlorine pesticides (eg. DDT) in the agricultural wastes are highly persistent and move along the food chains. In man DDT can accumulate in the body fat and affect the nervous system. (d) Some industrial effluents can cause changes in the colour, odour and taste of water in the natural water bodies. (e) Thermal pollution causes death of fish and increases the respiratory rate in microorganisms. (f) Contamination of water leads to spread of water borne diseases such as cholera, amoebiosis and others.

Control of Water Pollution: The following steps are being taken in India to control water pollution.

i) **Sewage Treatment:** It is done in three steps. In the first step suspended materials are removed. In the second step, the waste water is aerated. This promotes bacterial decomposition of organic compounds. This is followed by chlorination. In the third step nitrates and phosphates are removed and the water is purified.

ii) **Effluent Treatment:** Industrial effluents are suitably treated to eliminate the pollutants. The steps involve removal of toxic chemicals, neutralization of acids and alkalies, precipitation of metallic compounds and reducing the temperature of waste waters from power plants.

3. Soil Pollution

Soil pollution is caused by the improper disposal of solid and liquid wastes. It is mainly due to the injudicious application of agricultural chemicals or the result of acid rains. Soil pollutants include garbage (city refuse), industrial wastes, chemicals and sometimes radio nuclides. These lead to bad sanitation, encourage microbial activity and thereby cause many diseases.

Soil pollution can be controlled by transferring the refuse to safe discharge sites where the wastes are suitably treated. Materials such as paper, glass and plastics can be recovered and recycled. Metals can be recovered from the scrap. Biological methods of pest control can reduce the use of pesticides and minimise soil pollution.

4. Radioactive pollution

Radioactive pollution is due to the fall out from nuclear explosions and emissions from the industrial use of nuclear energy (see also, Part I, Chapter 8). Whether nuclear power plants are used for the manufacture of nuclear weapons or for producing

energy for peaceful purposes, large amounts of waste materials containing radioactive materials are produced. These radio isotopes can enter the body through the food chains. If people are exposed to ionising radiations they may develop cancer and genetic disorders. The best method of prevention of radio- active pollution is to stop nuclear proliferation and to keep the human populations away from the existing nuclear power plants. In India, the Health Physics Division of the BARC, Bombay is doing work on the control of radio active pollution.

5. Noise Pollution

Noise is defined as unwanted sound. One man's music may be noise to the other person. Whether a sound is pleasant or not depends upon its duration, loudness and the mood of the person. Noise is measured in decibels. Noise above 100 decibels is not comfortable to the ear drum. The sources of noise may be industries, automobiles, explosions, aircrafts and public address systems.

Noise pollution affects the eardrum. Long exposure leads to hearing loss. Noise can also cause anxiety, stress, increased heart beat, dilation of the pupil and even death.

Noise pollution in industries can be controlled by proper designing of the machinery and appropriate lubrication of machines. Noise generating equipment can be operated in sound proof chambers and workers can be provided with ear plugs.

It is interesting to note that the polluting effects of noise last only as long as the sources of noise are active. There is little residual pollution effect. This is in sharp contrast with other types of pollution, discussed above, where the effects may persist long after the cause is removed.

Activity 5.1 : Study of air pollution

Take two white painted boards. Place one along the road side and the other in a garden under a tree for about an hour. Observe the deposition of dust on the two boards. Give reasons for your findings.

Activity 5.2: Study of water pollution

Visit a nearby pond or river or any other water body. Look for sources of pollution such as sewage, chemicals, industrial effluents, etc. If the water bodies have lot of algal blooms, they are badly polluted.

RECYCLING OF WASTE MATERIALS

Introduction

Waste materials result due to the various activities of man. Many of these waste materials can be put to several constructive uses. This is because they contain many materials which can be recycled and returned to productive use. Both **biodegradable** and **non- biodegradable** wastes can be reused or recycled. For example, animal dung can be used for the manufacture of gobar gas (see part I Chapter 6). It is a good example of recycling a bio- degradable waste for the production of energy. Preparation of compost is another beneficial means of recycling biod-degradable wastes. Non biodegradable wastes such as plastics and glass are difficult to be recycled. Ideologically, recycling all the products of human activity would be desirable. But realistically, not all waste materials can be recycled. Some of the materials that are being recycled on a commercial scale are plastics, paper, glass, aluminium, iron, copper and rubber. (see also Part I, Chapter 6)

Why Recycling?

Recycling involves the following steps: separation, melting, purification (refinement) and recasting. The recycling plant and process must be economically viable and the product must be of an acceptable quality. This however is not the case with most of the recycling plants. Inspite of this, recycling is very important on account of the following reasons:

1. It helps in conserving the natural resources which are dwindling at a very rapid rate.
2. It helps in preserving bio–diversity.
3. It reduces waste accumulation and thereby checks pollution.
4. In many countries, including India, It has become an important generator of jobs and offers means of livelihood to many. In the USA, for every million ton of waste, approximately 2,000 jobs are created. In India, about 25 million people make their living by collecting and selling scrap, rag picking, recycling of waste paper, glass and plastic materials. Recycling involves lower capital requirement. It minimises import of raw materials and thereby saves valuable foreign exchange.

The following are three specific instances of the advantages of recycling:

1. Recycling of paper creates less demand for wood pulp. This would help in conserving our forests.
2. Recycling of aluminium cans means less mining of bauxite ore. Hence the ore is conserved for long term utility.
3. Recycling of municipal wastes results in the recovery of large quantities of paper, ferrous materials and aluminium. The residue can be converted into combustible soild fuel.

QUESTIONS

1. What is environmental pollution?
2. Can pollution of the environment occur without man's intervention? Explain.
3. Name the major air pollutants and their sources.
4. What are the causes for the following:
   a) smog.
   b) acid rain.
   c) greenhouse effect.
5. Briefly discuss the effects of air pollution.
6. Answer the following briefly :
   a) industrial water pollution.
   b) effects of sewage contamination on surface waters.
   c) thermal pollution
   d) soil pollution.
   e) radioactive waste disposal
   f) noise pollution.
7. Describe how recycling of waste materials helps in maintaining ecological balance.
8. Mention a few waste materials that are recycled in India.
9. What are the steps involved in recycling of wastes?
10. Why should we recycle materials even if the process is expensive?
11. Distinguish between biodegradable and non-biodegradable materials. Give two examples each.

UNIT II: FOOD AND HEALTH

Chapter 6: DEFINITIONS – CONSTITUENTS OF FOOD

Introduction

Food is one of the basic needs of all living organisms. Food is defined as a substance that nourishes the body. It can be either in solid or liquid form. The main functions of food are: it is used as an important energy source, provides materials for growth, helps to replace worn out tissues, maintains body temperature and helps in sustaining all the life processes. The term food is related to another term called **nutrition.** The method of obtaining food and its utilization in the body is called nutrition. Food, to a large extent, decides the health of the organism. **Health** refer to the general condition of the body. Good health means a body free of diseases and ailments. The useful components of food are called **nutrients.** Our body requires nutrients in adequate amounts. In order to understand the close relationship between food and health, an understanding of the constituents of food is essential.

Constituents of Food

The food we generally eat includes rice, chapathi, vegetables, fruits, dal, milk, egg, fish, meat, butter, oil, etc. These foods provide us various nutrients which can be classified into:

1. Carbohydrate
2. Proteins
3. Fats
4. Minerals
5. Vitamins
6. Water
7. Fibre (roughage)

Each nutrient has a specific function to perform. Based on their function, nutrients can be grouped into three categories.

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A. Body Builders: These are nutrients which help in the formation of tissues, which in turn build the body. Proteins, minerals and water are important body building nutrients.

B. Energy Producers: These are nutrients which on oxidation release energy required for life activities. Carbohydrates and fats are important energy releasing nutrients.

C. Regulators: These are required in small quantities. They regulate and co-ordinate the various activities of the organism. Vitamins and minerals are included in this category.

The body requires an optimum quantity of each nutrient. This ensures good health and proper growth. Less than or excess of the optimal quantity leads to ill health. The term **malnutrition** refers to under nutrition of inadequate supply of essential nutrients.

NUTRIENTS – Chemical Composition and Functions

1. CARBOHYDRATES

They are the major, naturally occuring nutrients which are essential both for the life of plants and animals. They are a group of biological macromolecules – so called because they are present in living organisms and have high molecular weight. They contain carbon, hydrogen and oxygen and can be represented by the general formula $(CH_2O)n$ (n = no. of carbon atoms). Oxidation of carbohydrates yields energy. A major portion (about 70 – 80%) of the energy requriement of our body is supplied by the carbohydrates.

Only green plants have the ability to synthesise carbohydrates by the process of photosynthesis. The requirements for this are water, carbon dioxide, sunlight and chlorophyll pigment in the leaves. The following equation summarises the process of photosynthesis:

$$6CO_2 + 12H_2O \xrightarrow[\text{Sunlight}]{\text{Chlorophyll}} \underset{\substack{\text{Glucose}\\\text{(carbohydrate)}}}{C_6H_{12}O_6} + 6O_2 + 6H_2O$$

Classification of Carbohydrates: Based on the number of sugar units, carbohydrates are classified into:

a) *Monosaccharides* (mono – one; saccharide – sugar unit)

They are simple sugars which are made up of a single sugar unit. They are soluble in water and sweet to taste. Examples: Glucose, fructose, galactose and ribose.

b) *Oligosaccharides* (oligo – few; saccharides – sugar units)

They are more complex than monosaccharides because they contain more than 1 sugar unit. The number of sugar units, however is limited to 2-4 only. They are also soluble in water and sweet to taste. The most common oligosaccharide is sucrose (cane sugar) which is made up of a molecule each of glucose and fructose. Hence, it can be called a **di-saccharide.** Other common disaccharides are maltose (glucose + glucose) and lactose (glucose + galactose).

c) *Polysaccharides* (poly – many; saccharides–sugar units)

They are the most complex carbohydrates made up of several hundreds of monosaccharide units. They are not sweet to taste and are insoluble in water. Examples are cellulose, starch and glycogen.

Sources of Carbohydrates in our Diet

The chief carbohydrate rich foods in our diet are cereals such as rice, jowar, ragi, wheat, pulses, tubers like potato and sweet potato, sugar, jaggery, milk, honey and fruits.

Activity 6.1: Tests for the presence of carbohydrates in food

a. Test for starch

Materials: Bits of raw or boiled potato, cooked rice or wheat flour, glass test tubes, water, iodine solution (3%)

Procedure :

1. Take 3 test tubes each with 1 ml water. Label them A, B and C.
2. Do not add anything to A. Add two raw or boiled potato pieces into B and cooked rice (1g) into C.
3. Stir the tubes thoroughly with glass rod.
4. Add two drops of dilute iodine solution into each tube.

Observation: Tube A : Blue colour does not appear

Tubes B & C: Blue colour is seen.

Conclusion: A blue colour with iodine would indicate the presence of starch.

b. Test for sugar

Materials : Small pieces of ripe banana, apple or fresh orange, test tubes, glass rod, Benedict's solution.

Procedure : 1. Crush each fruit separately, strain their juices and collect 1ml juice in separate test tubes.
2. Add a few drops of Benedict's solution to each.
3. Note the colour before and after addition of Benedict's solution.

Observation: Appearance of reddish–orange colour confirms the presence of sugars.

Nutritional significance of carbohydrates: (a) They provide most of the energy requirements of our body. (b) They are constituents of tissues.

How do carbohydrates release energy?

The utilizable carbohydrates in food–stuffs are predominantly starch, sucrose, glucose and fructose. All these are converted to glucose by enzymatic action during digestion. Glucose is then oxidised in the mitochondria of cells during cellular respiration to yield energy. So, the release of energy from food–stuffs involves two processes, digestion and respiration.

2. LIPIDS

Lipids are another category of important biological macro-molecules containing carbon, hydrogen, and oxygen. They are concentrated sources of energy, which ar generally stored in our body as energy reserves. Energy is released by the chemical breakdown of a lipid molecule followed by oxidation. Lipids are insoluble in water but soluble in organic solvents like benzene. toluene, chloroform and ether. The specific gravity is less than that of water. Examples are fats, oils, waxes and steroids.

Classification of Lipids: Based on their composition, five categories of lipids are recognized.

a) ***Acyl glycerols:*** They have a molecule of **glycerol** to which are attached 1-3 molecules of fatty acids. Fats and Oils, which are the important constituents of our food, are included in this category.

b) ***Phospholipids:*** They contain a molecule of glycerol to which are attached two molecules of fatty acids and one molecule of phosphoric acid. They are major components of plasma membranes.

c) ***Sphingolipids:*** They do not contain glycerol. They are present in animal cell membranes and nerve cells.

d) ***Waxes :*** Solid esters of long chain of fatty acids present in the skin, hair and feathers. Cuticle in the aerial parts of plants is also a coating of wax.

e) ***Steroids and related compounds:*** They do not contain fatty acids. Included in this category are steroids like cholesterol, terpene, hormones, vitamins and alkaloids.

Earlier, lipids were classified into: (a) **Simple lipids,** (b) **Complex lipids,** and (c) **Derived lipids.**

Dietary lipids

Fats and Oils are the chief dietary lipids. Both fats and oils are tri–acyl glycerols (one glycerol molecule esterfied to three fatty acids yields a triacylglycerol or triglyceride.

Fats are solids at room temperature (*eg.* butter, ghee) and are madeup of **saturated fatty acids.** [Fatty acids without double bonds. *eg.* palmitic acid]. Oils are liquids at room temperature. *eg.* coconut oil, vegetable cooking Oils like sesame, mustard, safflower, sunflower and groundnut oils. They have **unsaturated fatty acid** component. [Fatty acids with double bonds. *eg.*, oleic acid, linoleic acid].

Essential and Non-essential Fatty Acids

Human body needs several fatty acids. Most of them are synthesised in the body. However, there are certain fatty acids (mostly unsaturated) which our body cannot synthesise. Hence, these must be taken along with our food. Such fatty acids which

cannot be synthesised by the body and which should be present in our diet are called **essential fatty acids**, eg. linoleic and linolenic acids. On the other hand, those fatty acids which can be synthesised in the body and hence need not necessarily be a part of the diet are called **non-essential fatty acids**, *eg.:* Glycine.

Sources of Lipids in our Diet

Animal foods which are rich in fats are milk, butter, ghee, cheese, egg and meat. Nuts and oilseeds also provide fats. Vegetable cooking oils are extracted from oilseeds such as groundnut, sesame, mustard, sunflower, safflower and coconut. All the above are called **dietary fats** as they are an integral part of our diet.

Activity 6.2: Test for the presence of fats or oil

Materials : A few drops of vegetable oil, 5–10 groundnuts, white paper, water, and a smooth stone.

Procedure:
1. Add 2 drops of vegetable oil on a paper and 2 drops of water a little distance away.
2. Crush 2–3 ground nut seeds on the same paper away from the above two spots.
3. Dry the paper and hold it against a bright source of light.

Observation: The spots which appear transparent confirm the presence of oil. Water merely dries up but does not make the paper transparent.

Acrolein Test: When potassium bi–sulphate is added to a sample of fat or oil and heated, a pungent odoured Acrolein is produced. This confirms the presence of fats or oils.

Nutritional Significance of Lipids: (a) Fats and Oils are rich sources of energy. A gram of fat or oil provides much more energy than a gram of carbohydrate. (b) They are essential for the absorption of vitamins, A, D, E. K and carotenoids (provitamin A). (c) Fats are deposited in the adipose tissues. Stored fat serves as energy reserves at the time of starvation. (d) Steroids and related compounds are substances of intense biological activity. They regulate growth and development.

How do lipids release energy?

Fats and Oils, under the action of lipases present in small intestine are hydrolysed into glycerol and fatty acids. Fatty acids are further oxidised in the mitochondria of cells to release energy. Fats provide more energy than carbohydrates.

Lipid Deficiency Disorders

Deficiency of lipids in the diet causes **phyrnodema.** The diseases is characterised by the presence of skin eruptions on limb, particularly the posterior and lateral portions, on the back and on the buttocks. In children, the deficiency results in dry and thick skin.

Hydrogenation

We have understood that oils are triacyl glycerols which are liquids at room temperature and that they contain unsaturated fatty acids. By the process of hydrogenation, a portion of unsaturated fatty acids of oils can be converted to saturated fatty aicds. By doing so, oils can be solidified and made into fats. During hydrogenation, oil is heated to 150–200^{o}C and hydrogen is passed through it under pressure and in the presence of finely divided nickel a catalyst. This converts a portion of unsaturated fatty acids into saturated fatty acids which in turn transforms the liquid oil into soild fat, *eg.* Vanaspathi Dalda.

3. PROTEINS

The term '**protein',** is derived from a Greek word proteios which in English means 'of prime importance'. The term appropriately indicates the value of porteins in our diet and its importance in our body. Proteins are abundant in all living tissues. They are vital molecules in our body, performing several major life sustaining functions. They are also a type of cellular macromolecules.

Chemically, they are made up of C, H, O, N and sulphur. They can be defined as **polypeptides** – (poly – many; peptides – peptide bonds). Generally, a protein molecule is a long chain made up of hundreds of monomeric units attached to each other. The monomeric units are called **amino acids.** The chemical bond that holds adjacent amino acids in a protein is called the **peptide bond.** It is more like a chain of beads in which the chain represents the protein molecule and the beads represent the amino acids.

Amino Acids

As the name indicates, they are substances containing an **amino** group **(NH_2)** and a **carboxylic** group **(COOH).** There are 20 amino acids which are known to occur in proteins. Hence, these are called **protein amino acids.**

Ex : Glycine, leucine, phenyl – Alanine, Aspartic acid

In addition to these, our body has several **non-protein amino acids,** which do not form part of any protein molecule. Eg: B alanine, citrulline and ornithine.

Essential and Non–essential Amino Acids

Our body can synthesise most of the amino aicds but not all. Those amino acids that our body cannot synthesise have to be obtained from our food. Such amino–acids which have to be a part of our diet are called essential amino acids. *Eg:* Lysine, Valine. Other amino acids, which our body can synthesise and hence need not be an essential component in our diet are called **non–essential amino acids.** *Eg:* Glycine, Cysteine.

Classification of Proteins: Based on their composition, proteins are classified into 2 broad categories:

1. ***Simple proteins:*** These contain only amino acids. Eg: Albumin of egg, globulin of seeds, glutelins of cereals.

2. ***Conjugated proteins:*** These contain amino acids plus a non amino acid component. The non–amino acid component is called the **prosthetic group.** The prosthetic groups can be either a carbohydrate molecule, a lipid molecule, a phosphate molecule or a pigment molecule. Examples of conjugated proteins are glycoprotein, lipoprotein, phosphoprotein and chromoprotein.

Sources of Proteins

Proteins can be obtained both from plant and animal sources. While most plant sources provide some amount of protein, pulses, groundnuts, oil seeds and soyabeans are very rich sources of proteins. Among the animal sources, fish, egg, milk, meat and cheese are rich in proteins.

Activity 6.3: Test for the presence of protein in food

Materials: Test tube, bits of boiled egg white, concentrated nitric

acid, ammonium hydroxide solution, water, spirit lamp.

Procedure : 1. Take a few bits of white portion from a boiled egg in a test tube.

2. Add 2 ml of conc. nitric acid and heat the test tube gently. Do not boil it.

3. Pour out the acid carefully, wash the egg white with water twice; (is it white now?). Add few drops of ammonium hydroxide to the egg bits.

Observation: After step 2, the egg turns yellow and after step 3 it turns violet.

Conclusion: Presence of protein in the egg white is confirmed.

Other tests for proteins

(i) Lead sulphide (Acetate) Test

(ii) Biuret Test (iii) Millon's Reagent Test

Nutritional Significance of Proteins

The prinicipal functions of proteins in our body are: (a) They continuously build tissues in our body. (b) Maintenance of tissues and replacement of lost or damaged tissues. (c) As enzymes, they catalyse and regulate various biochemical reactions in our body. (d) As antibodies, they resist infections.

Protein Utilisation in the Body

Protein digestion starts only in the stomach where it is hydrolysed to amino acids. Amino acids are absorbed by the walls of intestine and join the blood stream, which takes it to the liver and other tissues, where amino acids are utilised for tissue building and tissue repairs.

Protein Deficiency Disorders

Two of the most common disorders seen in developing countries are (1) Kwashiorkor and (2) Nutritional Marasmus.

Kwashiorkor: This disease, first discovered in West Africa, is prevalent in all developing countries It generally affects children below 5 years of age.

It occurs in children who are deprived of adequate quantity of proteins in their diet. The diet however contains sufficient carbohydrates and ensures adequate calorie supply.

The symptoms of Kwashiorkor are retarded growth, swelling of abdomen, legs and feet (oedema), discolouration of skin and hair, muscle wasting and mental retardation. These effects are irreversible in prolonged protein deficiency. Severity of the above conditions may lead to death.

Nutritional marasmus: It is due to the consumption of diets markedly deficient in both proteins and calories. It is usually seen in infants (below one year) which are not nourished by mother's milk.

4. VITAMINS

Vitamins are a diverse group of organic compounds which are vital for normal growth and development. Unlike other nutrients, they are required in very small quantities. Many vitamins cannot be synthesised by the body, so they have to be procured through our diet.

Vitamins are classified into 2 groups on the basis of solubility: (a) **Fat–soluble vitamins** include vitamins A, D, E and K. (b) **Water Soluble vitamins** include vitamins in the B group and vitamin C.

The lack of or inadequate supply of vitamins causes specific **vitamin deficiency disorders.** Each vitamin deficiency causes a definite disorder in the body.

DIFFERENT KINDS OF VITAMINS, THEIR SOLVENTS, SOURCES AND DEFICIENCY DISEASES.

Sl No.	VITAMINS	SOLVENTS	SOURCES	DEFICIENCY DISEASES
1	Vitamin A	Oil	green leafy vegetables, Carrot, Fish Liveroil, Butter, Ghee	retarded growth, affects vision and health of skin.
2	Vitamin B1	Water	Soyabean, Whole Cereals, Milk, Green Vegetables, Sea Food, Meat, Fish, Egg, unpolihed rice	Causes Beri Beri, Excessive accumulation of water in the tissues of legs, cramp, pain, numbnes, palpitations, breathlessness, Cardiac problems at later stages.
3	VITAMIN B2	WATER	MILK, PEAS, YEAST, BEANS, GREEN, LEAFY VEGETABLE, EGG, LEVER, OIL SEEDS	AFFECTS, EYES, SKIN, & NERVES. EYE BECOMES SENSITIVE TO INTENSE SUN LIGHT. THIS CONDITION IS CALLED PHOTOPHOBIA. LESIONS OF SKIN IN THE CORNERS OF MOUTH

4	VITAMIN B4	WATER	GREEN VEGETABLES, WHOLE GRAIN, TOMATO. POTATO, GROUNDNUT, MEAT, FISH, TUBERS	CAUSES PELLAGRA CHARACTERISED BY 3D' SYMPTOMS i) DERMATITES (SKIN LESIONS ECZEMA) ii) DIARRHOEA (LOOSE MOTIONS) iii) DEMENTIA (MENTAL SICKNESS)
5	VITAMIN B6	WATER	YEAST, CEREALS, RICE, WHEAT, EGG, MILK, LEAFY VEGETABLES	RETARDATION OF GROWTH
6	FOLIC ACID	WATER	GREEN LEAFY VEGETABLES, PULSES, SPROUTED CEREALS, EGG, LIVER	CAUSES LOW HAEMOGLOBIN LEVEL IN BLOOD & DROP OF R.B.C. COUNT.
7	VITAMIN B12	WATER	MILK, MEAT, LIVER, MILK PRODUCTS	LOW RBC COUNTS IN BLOOD, PERNICOUS ANAEMIA, SORENESS, INFLAMATION OF TONGUE NUMBNESS OF FINGERS & TOES.
8	VITAMIN C	WATER	CITROUS FRUITS, LIME ORANGE, LEMON LIME, GUAVA, GOOSBERRY, GREEN LEAFY VEGETABLES, TOMATO, PAPAYA, SPROUTED PULSES	CAUSES SCURVY, CHARACTERISED BY GENERAL WEAKNESS, SOFT & BLEEDING GUMS, TENDER SWOLLEN JOINTS, BLEEDING IN TISSUES
9	VITAMIN D	OIL	MILK, FISH, LIVER OIL, EXPOSURE TO SUNLIGHT INITIATES SYNTHESIS OF VITAMIN D SUNSHINE VITAMIN	CAUSES RICKETS IN CHILDREN & OSTEOMALACEA IN ADULTS. SYMPTOMS OF RICKETS POOR GROWTH DEFORMATION OF BONES LEADING TO BOWED LEGS, DEFECTIVE RIBS
10	VITAMIN E	OIL	GREEN LEAFY VEGETABLE, TOMATO, MILK, BUTTER, CERELAC GERMOILS LIKE WHEAT GERM OIL, CORN GERM OIL, CEREALS, VEGETABLE OILS & FATS. ANIMAL FOOD	
11	VITAMIN K	OIL	SYNTHESISED IN THE BODY, GREEN LEAFY VEGETABLE, MILK, MILK PRODUCTS, LEGUMES & MEAT	DELAYS CLOTTING OF BLOOD, RESULTS IN EXCESSIVE LOSS OF BLOOD DURING AN INJURY.

5. MINERALS

These are inorganic nutrients which have an important role to play in growth and normal functioning of body. Our body has about 24 minerals, all of which must be procured through diet. The total mineral content amounts to 4-6% of our body weight. Most of them are taken in as constituents of various foods in the salt form and are functional in the body in ionic state. Some of the major minerals are calcium, iron, phosphorus, potassium, sodium, chlorine and magnesium. Others which are present in small amounts in the body are manganese, copper, iodine, cobalt, zinc and fluorine. Inadequate supply of these impairs the normal functioning of body and may even lead to serious deficiency diseases.

Important Minerals in Our Body

Calcium: Among the minerals in our body, calcium occurs in highest amount. Most of it is present in the skeletal system.

It is the chief constituent of bones and teeth. It is essential for normal clotting of blood, and functioning of cardiac muscles. Infants and growing children must have adequate supply of calcium in the diet for normal growth.

Milk and milk products, sesame seeds, green leafy vegetables, ragi and fish are rich sources of calcium.

Phosphorus: It is present in the form of phosphates or phosphoric acid.

Together with calcium, it is the chief constituent of bones and teeth as calcium phosphate. As phosphate ions and phosphoric acid it is present in all the cells and are important for various metabolic activities. It is a component of nucleic acids RNA and DNA.

Chief sources are milk and milk products, pulses, cereals (maize, bajra, ragi), nuts, oil seeds, fish and meat.

Iron: Most of the iron in the body is present as haemoglobin, a constituent of blood and muscles. In blood, iron acts as oxygen carrier. It is also necessary for the functioning of certain enzymes.

Chief sources of iron are green leafy vegetables (Amaranthus, coriander, mint), groundnuts, cereals and pulses.

Deficiency of iron causes **anaemia** (see Chapter 10).

Iodine: Iodine in small amounts is essential for the synthesis of **thyroxin**, a vital hormone in our body which is essential for normal growth and development.

Sea fish and sea food contains iodine. the common salt is fortified with iodine.

Iodine deficiency causes a disease called goitre (see Chapter 10).

minerals	Quantity per day	Major sources
Calcium	0.6-0.7 g	milk and its products, beans, green vegetables, whole gram, cereal, meat, fish, ragi, tapioca.
Phosphorus	1 g	milk
Iron	25 mg(boys)	liver and kidney, bajra and ragi, eggs, groundnuts,, 35 mg (girls)
Iodine	0.1-1.15 mg	fish, seafood (supplemented with iodine salts)
Sodium	1.1 g	common salt and most foods
Potassium	1.9 g	orange juice, milk, meat, vegetables, banana

Table 6.3: Daily Requirement of Important Minerals for 13-15 year-old and their Major Sources

Sodium: It regulates the acid-base balance in the body. It is also necessary for cardiac muscle functioning.

Chief sources are common salt, milk and milk products, egg, meat and fish.

Potassium: Most of the potassium in the body is present in the cells and in RBC. Like sodium, it regulates the acid-base balance in the body. It also influences muscular activity.

Potassium occurs in most foods, oilseeds, nuts, pulses, cereals, green leafy vegetables, eggs and fruits.

Sources of Minerals

Most of the minerals are taken into our body in their salt forms. Foods of both plant and animal origin have varying combinations of mineral salts. Except common salt, *i.e.* sodium chloride, none of the others are taken directly. Most of the minerals are water soluble and are released into the water while cooking. This water should not be discarded but consumed.

Nutritional Significance of Minerals: Minerals perform a number of functions in the body. Chief among them are (a) They are constituents of bones and teeth. (b) They help in maintaining the acid alkali balance in cells. (c) They are essential for maintaining normal tone of muscles, nerves and blood. (d) They are essential for the functioning of several enzymes.

Mineral Salt Dificiency Diseases

A balanced and optimal supply of minerals is essential for normal growth and functioning of our body. Inadequate supply of minerals leads to bodily disorders which can be termed mineral deficiency diseases. While inadequate supply of each mineral causes impairment of bodily functions, only two of the serious mineral deficiency diseases would be dealt with here.

Anaemia

Deficiency of iron and vitamin B12 causes anaemia. Anaemia refers to both low haemoglobin content in the blood as well as a drop in the number of RBCs in the blood. The cells of the body will be oxygen starved because of the diminished oxygen carrying power of blood. This affects all other metabolic activities. Anaemic patients, thus, become pale, tire easily and lose weight.

Goitre

Deficiency of iodine causes goitre. The clinical symptoms are enlargement of thyroid gland and a visible swelling in the neck. this is due to overgrowth of glandular tissue. As a result of goitre. thyroxin hormone is not produced in required amounts.

Goitre is prevalent in people living in hilly and mountainous areas. It is an **endemic disease.** Soils in these areas are generally iodine deficient and the plants that grow here have very low iodine content. Consequently, the food is iodine deficient and causes goitre in such people. People living in inland and coastal areas seldom experience iodine deficiency.

The Government of India has made it mandatory to sel iodised salt as it ensures adequate supply of iodine to our body.

6. WATER

It is the single most abundant substance in all living or ganisms. About 60-70% of the total body weight is water. The sof

tissues of the body contain 70-80% water, while the bones have 10-20% water content. It is an essential part of protoplasm in every cell. Though it is wrong to designate it as a type of food, it is present in all types of food. It is a universal solvent and is a constituent of all bodily fluids such as blood, lymph and urine.

Sources of Water

Drinking water provides bulk of the water requirement of our body. In addition, the beverages and juices contain plenty of water. Some amount of water is also present in food. Certain metabolic reactions in our body also release water which can be utilised by the body.

Nutritional significance of water: (a) It maintains the fluidity of blood and lymph. (b) It helps in elimination of waste materials from the body in the form of urine and sweat. (c) It replaces loss of fluids from tissues. (d) It regulates body temperature. (e) It maintains the electrolyte balance in cells and tissues.

Since water is continuously lost from the body in the form of sweat and urine, it has to be replenished in adequate amounts. If this is not done, it results in dehydration (inadequate water in the body). Severe diarrhoea and vomiting resulting in excessive water loss leads to dehydration.

Activity 6.4: Test for the presence of water in food

Materials: About 5 grams of fresh potato slices, ash-gourd slices, rice grains, petri-dishes, weighing balance.

Procedure:
1. Weigh 5 grams each of all the plant materials Given above and keep them in three separate petridishes.
2. Keep them in bright sunshine for six days
3. At 2-day intervals weigh each sample and record the weights.

Observation: You will notice that potato and ash-gourd pieces would have lost weight while the weight of rice grains remains more or less unchanged.

Conclusion: The weight lost in potato and ash-gourd is due to evaporation of water. Rice grains are already dry and hence do not lose much weight.

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7. ROUGHAGE (FIBRES)

Roughage is not a food because, like water, it neither releases energy nor helps in tissue and body building. However, it is very essential for the normal functioning of the digestive system.

Polysaccharides such as cellulose, hemicellulose, lignin, pectin which are present in most foods of plant origin cannot be hydrolysed (digested) in our body. Such substances are collectively called roughage.

Sources of Roughage: Most plant foods contain a certain amount of roughage. the chief sources are vegetables such as carrots, turnips, peas, cabbage and fruits whose skins are edible such as apple, guava, pear, cereals and pulses.

Nutritional Significance: Because of their ability to absorb water. roughage helps in the elimination of intestinal wastes. They combine with the intestinal wastes, adding to their bulk. This expands intestinal lumen and stimulates movements in the gastro-intestinal tract. This is helpful both for the passage of food and elimination of intestinal wastes.

BALANCED DIET AND ENERGY REQUIREMENTS

For maintaining good health, normal growth and development, the food we eat (diet) should provide us adequate amounts of all the nutrients. Such a food which provides us all the nutrients is called **balanced diet.** So a balanced diet contains adequate amounts of all the essential nutrients that we just studied. To ensure this the diet needs planning. Haphazard eating, eating at irregular intervals, eating junk food does not give us all the nutrients our body needs. The average energy requirements are given in table 6.5. The diet must also contain all the other nutrients in amounts mentioned in tables 6.2 and 6.3. To achieve this, the food we take must include cereals, pulses, fruits, vegetables, milk and egg.

Let us list the usual food-stuffs we eat and understand the nutrients they provide us (table 6.4).

	Foodstuff	Nutrient
1.	Cereals, rice and wheat preparations such as idli, roti, bread, poori, potatoes, sugar, honey, jaggery, fruits, sweet potato.	Carbohydrates
2.	Butter, ghee, groundnut oil, vegetable oils, meat.	Lipids
3.	Meat, fish, milk, groundnuts, pulses, cheese, eggs.	Proteins
4.	Milk and milk products, cereals, green leafy vegetables, egg, liver, meat, dry fruits, common salt.	Minerals
5.	Cereals, milk, fish, butter, oils, vanaspathi, sea food	Vitamins
6.	Fruits, vegetables, cereals, pulse	Roughage
7.	Beverages like coffee, tea, fruit juices	water

Table 6.4: Foodstuffs and their Nutrients

When a diet is planned, we have to keep in mind its nutritional or calorie value. Calorie is a unit of energy which is defined as the amount of heat required to raise the temperature of 1cc of water through $1^{o}C$. The energy requirement in terms of calories depends on various factors like age, sex, height, weight, occupation and state of health. Hence the energy requirement is not the same for all individuals at all times [see figure 6.1 and table 6.5]. No single food provides us all the nutrients we require. Hence we have to choose a number of food items to make up a balanced diet. Balanced diet does not mean a stomach full of only one type of food but that which provides us all the nutrients in adequate amounts.

Group	Body Wt in kg	Net Energy in kCal	Protein in g	Fat in g
Adult Man	60	2875	60	20
Woman	50	2225	50	20
13-15 Yrs Boy	47-48	2450	70	22
Girl	46-47	2060	55	22

Table 6.5: Recommended daily allowances of energy, proteins and fats

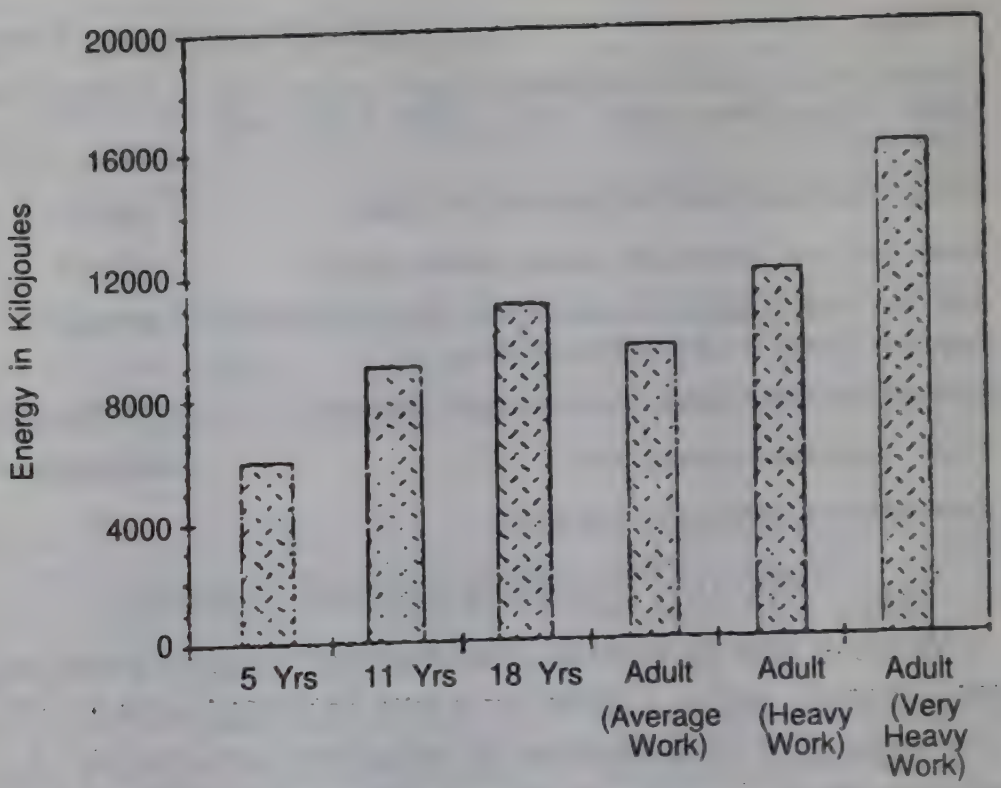

Figure 6.1: Energy Requirement varies with Age and Occupation

QUESTIONS

1. Define food. State the important functions of food.
2. Why are carbohydrates called energy foods?
3. Are minerals essential in our diet? Justify your answer.
4. Write the important functions of water in our body.
5. What major nutrients do the following food items contain?

   a) potato b) rice c) pulses d) meat
   e) egg white f) milk g) groundnut
6. Write the general formula of a carbohydrate.
7. How are carbohydrates classfied? Give an example for each category.
8. Write the recent classification of lipids.
9. What are dietary lipids?
10. Differentiate between:

a) saturated and unsaturated fatty acids.
b) essential and nonessential fatty acids.
c) protein amino acid and non-protein amino acid.
d) simple and conjugated proteins.

11. How do you test for the presence of starch in food?

12. Define the following:

a) nutrition
b) peptide bond
c) hydrogenation
d) fat soluble vitamins
e) photophobia
f) anaemia
g) endemic disease

13. Give reasons for the following:
a) patients are generally given glucose and not starch.
b) we are advised to take iodized salt.

14. Name the important protein deficiency disorders. Write their symptoms.

15. What are vitamins? On what basis are they classified?

16. Mention the deficiency disorders of the following vitamins: A, B1, B6, B12, D.

17. Write the important functions of minerals in our body.

18. Define balanced diet. Why do we need a balanced diet?

19. Roughage and water are not foods. Why?

20. A stomach may be full of food, but may not be a balanced diet. Explain.

Chapter 7: FOOD PRODUCTION

Introduction

In the earlier chapter, we have learnt that all the food we eat has basically either a plant or animal origin. So it is necessary for us to learn how plants are scientifically cultivated and animals are domesticated for our benefit. The science of crop cultivation or farming is called **agriculture** and the science of animal rearing and domestication is called **animal husbandry.** In this chapter, let us take a look at the various practices followed in agriculture and animal husbandry. Knowledge of these is very essential for planning, sustaining and increasing the food yield.

The early man obtained his food mainly by hunting animals. Much later (about 10,000 B.C.) he discovered that plants also can be a source of food. So he started carefully selecting the useful plants from nature and growing them near his place of dwelling. But he soon realised that after rising few crops the land became infertile and unsuitable for further cultivation. So he abandoned it and moved into a new area and started cultivation there. Abandoning the land and cultivting in a new land became a feature of his life. The term nomad is applied to such a wandering way of life, and the type of cultivation is called **shifting cultivation.** As a result, the early man never settled at a place. Though he accepted agriculture and animal husbandry as an integral part of his life, the nomadic way of life caused difficulties to him. So he started thinking of leading a settled life. Gradually, throughpersistent efforts, he evolved better agricultural practices which enabled him to raise several crops in the same land. Evidences of such practices and settled life could be seen in areas of early civilizations like the Indus Valley Civilization. The explosion of knowledge during the 19th and 20th centuries benefited agriculture and animal husbandry. Research by agricultural scientists have helped evolve scientific methods of cultivation, soil management, production of hybrids and new varieties of crop plants through scientifically managed breeding programmes. Similarly, the quality and yield of domestic animals have also shown significant improvement, thanks to research in animal husbandry.

Let us take a closer look at the modern approaches to agriculture and animal husbandry.

A. Essentials of Agriculture and Farm Management

In order to meet the food requirements of a country, the agriculture needs extensive planning. Scientific approach to cultivation has yielded good results. We have more or less attained self-sufficiency in food production in our country.

For proper cultivation of crops a knowledge of the following is necessary:

1. Soil Management
2. Irrigation
3. Crop protection
4. Crop improvement

1. Soil Management

Soil can be defined as the superficial cover of the earth's crust. It is a mixture of minerals, organic matter, water and air. It is the natural medium for the growth of plants. It provides substrata for plants. Soil is rich in soil micro- organisms, some of which are essential for plant growth.

For getting good yield and maintaining the soil fertility it is necessary to understand the following aspects of soil management: (a) Land Preparation (b) Sowing (c) Application of manures and fertilizers (d) Soil testing.

a) Land Preparation: Preparation of land for cultivation is called tilling. It is done in two stages: a) Primary tilling and b) secondary tilling. Primary tilling involves opening up of land, crushing the cluds, pulverisation and levelling. This improves aeration and water-holding capacity of the soil. Primary tilling is done by machine ploughs or wooden ploughs (figure 7.1). Secondary tilling involves ploughing the land after sowing but before harvesting the crop. It loosens the soil and also eliminates weeds. Small implements like Kunte and hoes are used for secondary tilling.

b) Sowing: Placement of seeds in the soil for proper germination is called sowing. This can be done either manually or by **seed drills** (figure 7.2). The two chief factors that are to be kept in mind are the quality of seeds and method of sowing. Seeds should be

treated with fungicides and insecticides to prevent seed-borne diseases and insect infestation. Sowing seeds either too deep or on the surface of the soil does not ensure proper germination. Seeds should be sown at proper depth and with adequate spacing. Use of seed drills helps in proper placement of seeds and also enables simultaneous application of fertilizers. Manual sowing may result in poor germination due to uneven distribution of seeds.

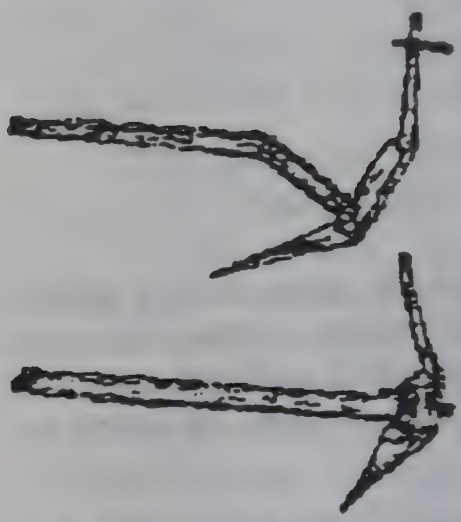

Fig. 7.1 Ploughs

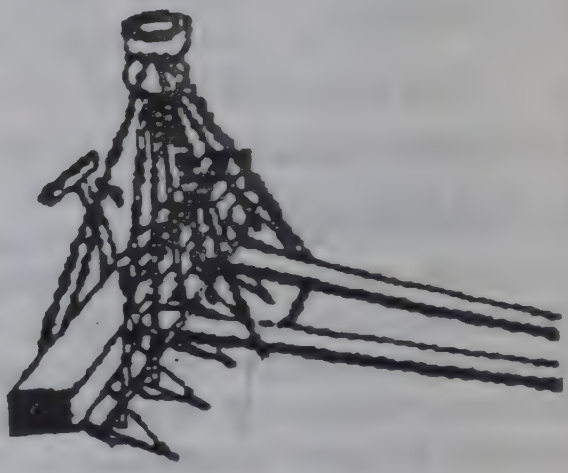

Fig. 7.2 Seed Drill

Most of the crops are grown by sowing seeds directly in the soil. But crops like paddy, tobacco and vegetables have small seeds because of which uniform sowing becomes difficult. Hence, they are first sown in a small area called the nursery to raise seedlings. Seedlings are later transplanted to the main land.

Activity 7.1: Sowing and germination of Seeds

Materials: 4 garden pots and 20-25 bean seeds.

Procedure:

1. Prepare the pots for sowing the seeds. Label them A. B, C and D.
2. Place 4-5 seeds in each pot at the following depths: A-1 cm, B-4 cm, C-7 cm and D-10 cm
3. Water the pots daily.

Observe the seeds that germinate in each pot, count them and give reasons.

---

c) Application of Manures and Fertilizers: Plants absorb various mineral salts and water from the soil. After a certain period of time, soil gets depleted of minerals and water. Unless these are periodically replenished, the soil becomes infertile, less productive and unsuitable for cultivation.

Plants require about sixteen elements for their growth. Elements such as carbon, hydrogen, oxygen and nitrogen which are required in large quantities are called **macronutrients.** Iron, Zinc, molybdenum, copper, boron and fluorine are called **micronutrients** since they are required in small quantities. A good soil must have adequate quantities of all the nutrients. Deficiency of any nutrient results in poor growth of plants which in turn adversely affects the yield. Thus, periodic enrichment of the soil is very essential. This is done by the application of manures and chemical fertilizers.

Manure is an organic substance obtained from the decomposition of plant and animal wastes by the action of microbes. They contain a mixture of various nutrients. They restore soil texture for better water retention and proper aeration. Manures improve the overall physical, chemical and biological properties of soil. Traditionally, Indian farmers use animal dung as natural manure. **Compost** is another natural manure prepared from agricultural wates or city garbage. The latter are dumped in pits and allowed to decompose and mineralise, after which they can be used as a natural manure. Natural manures are also called **organic manures or natural fertilizers.**

Cultivation of crops using only organic manures is called **organic farming.** As no chemical fertilizer is used, the produce is relatively pollutant free. Though natural fertilizers enrich the soilwith nutrients, they may not be able to supply all the nutrients in adequate quantites. To overcome this, **chemical fertilizers** with known formulae of nutrients have to be used. Chemical fertilizer is a man made mixture of chemical compounds rich in essential plant nutrients like nitrogen, phosphorus and potassium (NPK). Each crop has a specific requirement of NPK. Several NPK combinations of fertilizers are available in the market. Farmers should know the correct NPK requirement of the crop and apply the right combination of NPK fertilizer to get maximum yield.

NPK fertilizers used in agriculture are: (a) **Nitrogenous fertilizers:** urea, ammonium nitrate and sodium nitrate. (b) **Phosphatic fertilizers:** Super phosphate, di-ammonium phosphate (DAP), and ammophos. (c) **Potassium fertilizers:** muriate of potash (MOP), potassium sulphate and potassium nitrate.

Chemical fertilizers should be very judiciously used, right quantity at the right time. Continuous and excessive use deteriorates the soil. Further, it also causes water pollution when carried off by flood waters into ponds, lakes and rivers.

Many living organisms such as *Azolla, Nostoc, Anabaena* (blue-green algae), *Rhizobium* (bacterium) can also enrich the soil and act as fertilizers. They are called **bio-fertilizers.** They enrich the nitrogen content in the soil.

A balanced application of natural manures, chemical fertilizers and bio-fertilizers preserves all the soil properties and makes it fit for cultivation year after year.

d) Soil Testing: Physical properties of the soil and soil PH value get altered due to use of chemical fertilizers. As crops require specific texture and an optimal range of pH, it is necessary to test the soil. This is done in soil testing laboratories which also guide the farmer on the correct usage of chemical fertilizers.

Soils with a pH value between 6.5 – 7.5 is close to **neutral** and is good for growth of most plants. pH values below this makes the soil **acidic,** and above this makes it **alkaline.** pH can be easily tested by using pH paper.

Activity 7.2: Estimation of soil pH and determination of the nature of soil.

Materials: 2-3 test tubes, soil samples (5 g each), distilled water, pH paper, colour chart

Procedure: Take a small quantity of soil in a test tube. Add water and shake thoroughly. Allow the larger soil particles to settle down. Dip a pH paper in it. Match

the colour with the colour chart to know the pH.
Repeat the experiment with different soil samples.

Classify them into neutral, acidic or alkaline soils.

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2. Irrigation

Water is very essential for growth of plants. Rainfall is the chief and the most natural supply of water. But rainfall does not occur throughout the year. We get rains only during the monsoon months every year. Thus, during lean periods, stored water from ponds, wells, tanks and reservoirs are supplied to crops. This method of supply of stored water for cultivation of crops is called Irrigation.

There are four methods of irrigation each suited for a specific type of crop. They are:

1. **Check Basin Method:** For crops such as maize, wheat, jowar, bajra, pulses and oil seeds, paddy.

2. **Ridges and furrows method:** For crops such as cotton, sugarcane, sunflower, potato, chillies, tomato.

3. **Sprinkler system:** For crops such as coffee and fodder crops

4. **Drip irrigation:** For orchards cultivating mango, guava, citrus fruits, banana, pomegranate and coconut.

The check-basin method is widely used for cultivating a variety of crops in India. In this method, land is divided into several squares or rectangular **check basins** surrounded by bunds. The land within the check basin is levelled for cultivation and water is fed through small, relatively level, plots surrounded by ridges. The water-fed areas are called field ditches.

In the ridges and furrows method, the land is ploughed deeply, leaving prominent ridges where soil is raised above and furrows which are channels between ridges. The ridges and furrows alternate with each other. The ridges support the plant and water is fed into the furrows.

In the sprinkler method water is applied in the form of thin spray. This method is also useful for cooling the crops during summer.

Drip irrigation or trickle irrigation is a recent invention for slow (drop by drop) application of water. This method ensures sufficient water percolation, prevents water wastage and minimises loss due to evaporation.

Water Lifting Devices

Several traditional devices are in use in our country. Most of these work with human or animal power, *eg:* swinging basket persian wheel mhota and pivot. Now-a- days, pump sets are used to lift water from ponds, bore-wells and open wells. These pumps can be operated either electrically or with diesel power.

3. Crop Protection

Safeguarding the plants from diseases, weeds and other harmful external agencies is called crop protection. The two main aspects of crop protection are: a) Control of weeds, and b) Control of disease.

a) **Control of Weeds:** Weeds are unwanted plants growing amidst crop plants. They compete with the crops for space, sunlight and nutrients. The crops are thereby deprived of optimal conditions of growth. This affects the yield. The common gregarious weeds in agricultural fields are several grasses, sedges, Eupatorium, Lantanna and Parthenium. De-weeding, an operation for removal of weeds, is necessary to ensure proper growth of crop plants.

The spread of weeds can be controlled by the following methods:

i) **Mechanical Method:** In this method, weeds are removed by ploughing or hand picking.

ii) **Chemical Method:** In this method, certain chemicals called **herbicides** are used to destroy weeds. 2, 4-D (2,4-dichlorophenoxy acetic acid) kills dicot weeds; Gyphosphate and Triazinas control monocot weeds. Butachlor, Alachlor and Nitofen are some of the other common herbicides.

iii) **Biological Method:** In this method, living organisms are employed for destroying the weeds, *eg:* herbivorous fish and geese

feed on aquatic weeds; mexican beetles feed on Parthenium; Cassia plants prevent growth of Parthenium.

iv) **Cropping Methods:** Methods such as crop rotation and **multiple** or **mixed cropping** helps in controlling weeds and also minimise the loss due to failure of one crop.

The practice of growing different crops at different times but on the same piece of land is called **crop rotation.** Generally, cereals and pulses are grown alternatively in crop rotation practices. Besides controlling growth of weeds, pulse crops enrich the soil with nitrogen through the agency of a bacterium, Rhizobium, which is present in the roots of leguminous (pulses) plants. So, the nitrogen used up by the cereal crop will be made good by growing legume plants.

The method of cultivation of two or more crops simultaneously in the same field is called **inter-cropping** or **mixed cropping.** Common mixed cropping patterns involve cultivation of turmeric and banana in coconut gardens; ragi and red gram, groundnut and red gram.

b) **Control of diseases:** Diseases of crop plants account for reduced yield and considerable loss of revenue. Plant diseases are caused by micro-organisms such as fungi, bacteria and viruses or insect pests. Nematodes, rodents and birds also contribute to reduced yield. A few common diseases of cereal crops are smut, ergot, brown rust and blast of paddy. The spread of diseases may be through the agency of

i) seeds (seed borne diseases)
ii) soil (soil borne diseases)
iii) air (air borne diseases)

Seed-borne diseases can be prevented by sowing healthy seeds and by treatment of seeds with chemicals that kill pathogens. Soil–borne diseases can be prevented by using soil disinfectants and by crop rotation. Air-borne diseases are controlled by spraying fungicides and chemicals. Spraying specific chemicals also destroys others pests like insects and rodents.

Thus, use of pesticides and fungicides in agriculture is inevitable now-a-days. Many of these are toxic to our health. Indiscriminate use of these will lead to environmental hazards. Therefore, their application must be done by trained persons and with utmost care. Only recommended dosages have to be applied

and the applicator should wear mask and gloves to prevent prolonged exposure to these chemicals while spraying.

The concept of **biological control** of pests is of recent origin. This involves use of specific living organisms against pests. For example, species of the insect Trichogramma are useful in controlling the stem borer of sugarcane and also to destroy eggs of cotton ball worms. Insect Crysoperla (green lace-wig) is used to control mealy bugs which destroy fruit and vegetable crops. The biological control of pests does not cause any pollution and the organisms themselves are harmless and easy to eliminate later.

4. Crop Improvement

Agricultural scientist are continuously trying to produce better varieties of crop plants. They are striving hard to obtain diseae resistant, drought tolerant and high-yielding varieties of plants. Conventionally, they have been doing this by the process of **hybridization.** Hybridization is a technique in which two different varieties (of a species) with desirable characters are crossed to get a new progeny called the **hybrid.** A good hybrid will have desirable characters of both the parental varieties.

Now-a-days advancements in science have provided better, quicker and far more reliable techniques for evolving hybrids and new varieties of crop plants. The technique of **plant cell and tissue culture** has been a boon to the agricultural scientists. Plant tissueculture involves growing plant cells, tissues or protoplasts on a synthetic **nutrient medium** under controlled conditions. Through this technique, they can experiment on plants in completely artificial conditions in the laboratories and obtain better varieties of crop plants. This method not only minimises the duration of experimentation but also overcomes the uncertainties that are prevalent in conventional breeding programmes.

B. Animal Husbandry

Though plants are the main source of food for us, animals including birds are also important food sources. They provide us milk, eggs and meat. Domestication of animals is a common practice in villages. In towns, animal rearing is undertaken on a commercial scale. The animals which are reared are cow, buffalo, sheep, goat, pigs and birds like chick, geese, fowl, etc. The livestock need proper care, shelter, feeding and protection against diseases and enemies. The branch of science which deals with feeding, rearing and breeding animals for food and other uses is called **animal husbandry.**

Management of Live-stock

Scientific management of live-stock calls for an understanding of the following factors: (a) feeding, (b) shelter, (c) animal health, and (d) animal feeding.

a) Feeding: Proper feeding ensures better growth of animals. Cattle are the most important of live–stock. The yield of milk is largely dependent on the type of fodder supplied to cows and buffaloes. The fodder generally consists of both roughages and concentrates. The roughages are hay, straw and silage. The roughages have high fibre content. Concentrates are rich in nutrients such as carbohydrates, proteins, vitamins and minerals. Cereals, millets, grams, cotton seeds and oil cakes form a part of their diet. Cattle fed with both roughages and concentrates in adequate amounts give high yield of milk and meat.

Sheep and goat rearers feed them with mineral mixtures and oil cakes apart from pulses, corn and jowar. A combination of these feeds increases the yield of meat.

The poultry birds are fed high nutrient foods such as mashed cereals, groundnut cakes, fish and meat meal prepared from the wastes of fish and meat processing industries. These foods greatly enhance the egg and meat output.

Pig is an omnivore as it can eat all types of food. A mixture of coarsely ground cereals, tamarind seeds, root crops like casava, potato and sweet potato are good feeds for pigs.

b) Shelter: Providing suitable shelter for the domestic animals is an important part of animal husbandry. Well lighted shelter with good ventilation and hygienic disposal of excreta protect them from many diseases. This greatly influences the yield from animals. Proper enclosures are particularly essential for birds to keep the predators away.

c) Animal Health: The efficient and profitable management of live-stock depends to a large extent on the health of animals. Healthier the animals, more productive they will be. Like human beings, animals are also prone to infections and diseases. Diseases are caused by micro-organisms like bacteria, virus and fungi. The spread of diseases can be very rapid in a farm. It is mainly due to lack of adequate knowledge of the diseases and poor, unhygienic conditions in the farms. Table 7.1 provides some basic

Chapter 8: POST–HARVEST MANAGEMENT OF FOOD

Introduction

In our country, nearly 10% of the food produced goes waste because of improper and unscientific storage practices. If producing more and more food grains is necessary, storing them properly is equally important. If this is not done, our success in achieving higher yield and food output would not have its desired beneficial effect.

Why should we store food ?

Many of our crops are seasonal. To ensure adequate supply of food-stuffs for our consumption round the year, we have to store them properly. Further, It also provides the farmers good and healthy seeds for cultivation in the next season.

The harvested food grains, vegetables, fruits undergo several internal changes during storage. If proper storage methods are not followed, deterioration of food porducts takes place. As a result, the nutritive value of food gets reduced. Further, food may become toxic and unfit for human consumption. This process of deterioration of food and loss of its nutritive value is termed **food spoilage.** Consumption of such food is dangerous to our health.

Factors responsible for Food spoilage and wastage

They can be classified into: 1) internal factors, and 2) external factors.

1. Internal Factors

Factors within the food stuffs that are responsible for spoilage are called internal or intrinsic factors. Let us study some of these.

a) Moisture content of food materials: Most food materials have a certain percentage of moisture in them. It is high in fruits and vegetables. All the plant products also respire during storage and release heat. Several chemical changes occur internally in the food-stuffs. The moisture content and heat encourage the growth of microorganisms on these food-stuffs. High moisture content increases the growth of microorganisms which results in food spoilage. It also promotes sprouting of stored grains, potatoes and onions. Thus, one has to know the maximum permissible levels of moisture for each food material to ensure proper storage. For food

grains, such as rice, jowar, ragi and wheat the internal moisture levels should not be higher than 14% during storage.

Activity 8.1: Moisture content in food materials and food spoilage

Materials: Two pairs of petridishes and dry pulse seeds

Procedure:
1. Clean, dry and label the petridishes A and B.
2. Place 10 dry seeds in A and 10 wet seeds (previously soaked in water for 5-6 hours) in B.
3. Keep the petridishes in a cool and dry place.

Observe the seeds at two day intervals for 10 days. Record your observations and give reasons.

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b) Action of enzymes: Plant and animal cells contain several enzymes. Some of these are active even during storage. Ripening of fruits, spoilage of fruits, vegetables and meat are partly due to continued enzymatic activity during storage. Hence, necesary conditions to stop enzymatic activity have to be taken into consideration. These, if ignored, encourage microbial attack.

2. External Factors

The factors that are in the surroundings of the stored food materials which cause food deterioration are called external or extrinsic factors. The important external factors are:

a) Temperature and humidity
b) Storage structures
c) Microorganisms
d) Insect pests and
e) Rodents and birds

a) Temperature and humidity: They play a vital role in storage. Temperatures between 20°C and 35°C are favourable for growth of microorganisms. Storing food at low temperatures (below 12°C) prevents microbial activity and food materials will not get spoilt. Similarly, high humidity promotes growth of fungi (molds) on food stuffs.

Activity 8.2: High atmospheric humidity results in food spoilage

Materials: Two pairs of petridishes, dry pulse seeds and filter paper.

Procedure:
1. Cut the filter paper into disks so as to fit inside each petridish. Label the petri-dishes A and B.
2. Wet the filter paper with water and place 10

seeds each in A and B.

3. Daily add just enough water to wet the filter paper in A, but add excess water to B.

Observe at two day intervals for ten days. Record your observations and give reasons. How is this activity different from activity 8.1?

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b) **Storage structures:** The structure and design of stroage devices and the type of material used in their manufacture are important for proper storage. Use of damp-proof materials prevents attack by fungi. Citrus fruits such as oranges and lemon should not be packed in metallic containers. This is because the citric acid present in these fruits reacts with metals to produce toxic materials. Lead containers should be avoided as lead is poisonous. Thus, containers and their materials should be carefully chosen for different food materials.

c) **Microorganisms:** We have learnt that temperature and humidity influence the activity of microorganisms on stored food. Bacteria, fungi (molds) and yeast cause considerable damage to food materials. The action of some of these organisms releases poisonous substances called toxins which are harmful to human health.

d) Insect infestation: Insect infestation is very common in food grains stored by improper storage methods, storage structures made out of non damp-proof materials enable insect infestation. Put fill fx... ^F rice moths in rice bins. The white worms often seen in rice are larvae of rice moth. Insects damage the kernels. Some common insect pests of cereals and pulses are rice moth, rice weevil. Pulse beetle and mites (figure 8.1)

e) **Rodents and birds:** Rodents cause extensive damage to food grains. Bandicoots, squirrels, mice and rats are common food destroying pests. A rat, on an average eats 30-35 grams of food grains per day. Nearly 2.5% of food-grain loss during storage is due to rodents. Apart from the loss due to consumption by these pests they contaminate food grains with their faecal matter urine and hair, which may cause and spread serious diseases.

Birds eat large quantities of food grains both before and after the harvest. They also damage fruits and vegetables and contaminate them with their excreta. Sparrow, mynah, pigeon, crow,

parrot are some of the common grain eating birds. They eat anywhere between 8-25 grams per day.

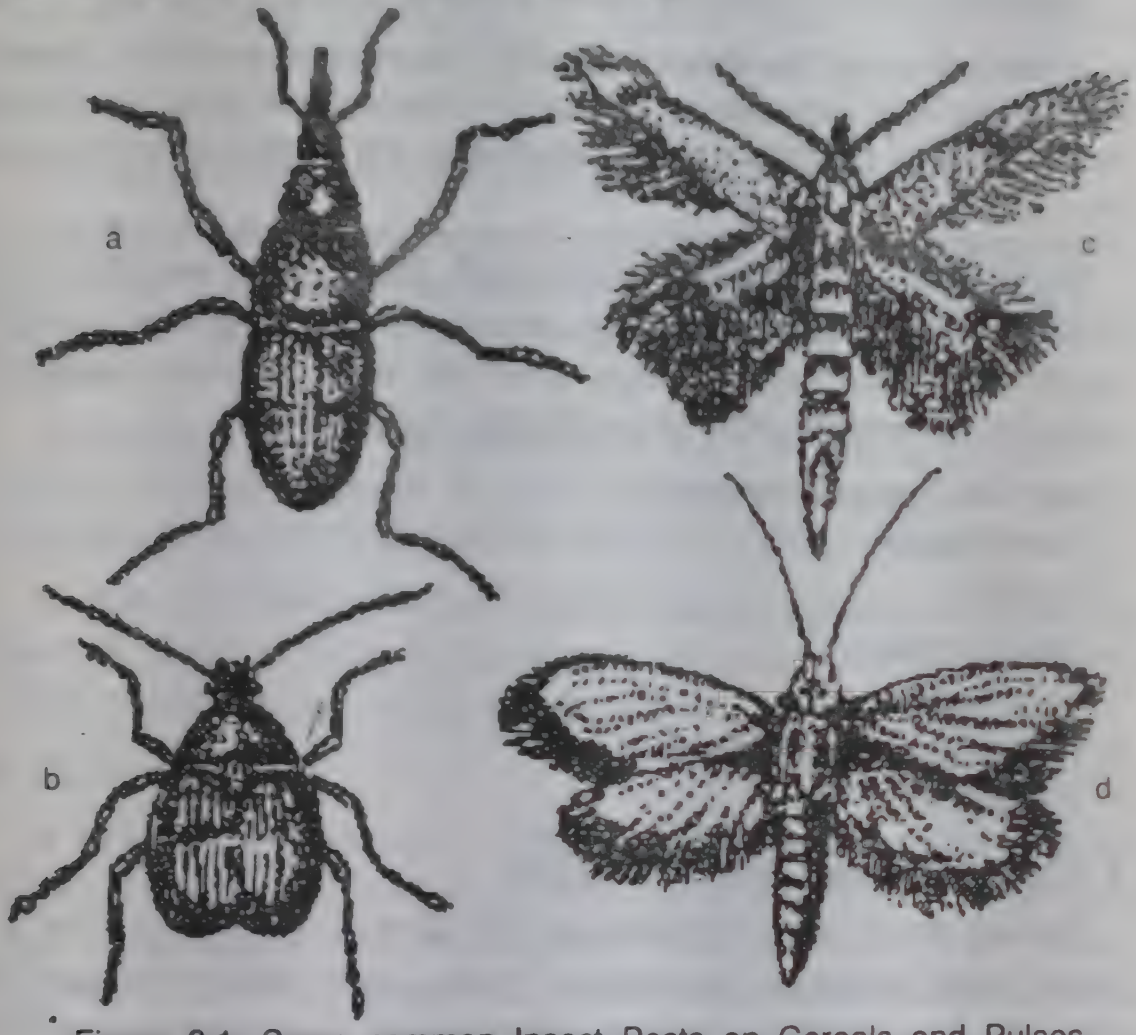

Figure 8.1: Some common Insect Pests on Cereals and Pulses

[a – Rice Weevil b – Pulse Beetle

c – Grain moth d – Rice moth]

Methods of Food Storage and Preservation

Depending on the longevity in storage all foods can be classified into two major groups.

(a) **Perishable foods** such as fruits, vegetables, milk and its products, meat, fish, cooked food, etc., which get spoilt in a short duration.

(b) **Non-perishable foods** such as pulses and cereals which do not get spoilt over a short period of time.

Activity 8.3 : To test the longevity of perishable foods

Materials : Some fruits like apple, banana, guava, orange and bread

Clean and keep the above materials in a cool and dry place. Observe them at two-day intervals for a fortnight. Record your observations and list the items in an order from the shortest to the longest in terms of shelf life.

Perishable foods have a short **shelf life**. Hence, we must have suitable storing methods through which we can retain their nutritive quality and also increase their shelf life slightly. Given below are methods of preservation of perishable foods.

1. Cold storage and freezing
2. Dehydration
3. Canning
4. Pasteurization
5. Chemical method
6. Wrapping or coating method
7. Irradiation

1. Cold Storage and Freezing

Storing foods in cold temperatures in the range of 6 - 8° C is called **cold storage**. Vegetables, fruits, meat, fish, milk and milk products are generally stored by this method. Cold temperature slows down the general metabolic rates of food and also lowers the enzymatic activity in them. It also prevents growth of micro-organisms such as bacteria and fungi on food-stuffs. The domestic refrigerators work on this principle. Food kept in a refrigerator does not get spoilt quickly unlike those kept at room temperature.

Storing foods below 0°C is called **freezing**. Frozen food is very useful for long distance transport that involves several days. Fruits, vegetables, meat, fish and other animal products are frozen, packed and transported. Freezing totally prevents enzymatic action and microbial activity. Hence the food materials do not undergo any change in storage.

2. Dehydration

This method involves the removal of excess water contained in the food-stuff, without destroying the nutritive value. Some fruits and vegetables like grapes, potatoes, onion flakes can be preserved by this method.

Dehydration can be done by any of the follow..ıg methods :

(a) **Sun Drying** : This involves exposure of food material to sunlight for drying. Different food materials require different durations of exposure to sunlight. Cereals and some fruits are dehydrated by this method.

(b) **Vacuum drying** : In this method, the food material is dried in a vacuum chamber. Useful in dairy industry to prepare milk powder, cheese powder, ice-cream powder and other milk products.

(c) **Hot air drying** : In this method, hot air is blown over the food material. Fruits and vegetables such as grapes, potatoes, onion flakes which cannot be sun-dried are dehydrated by this method.

3. Canning

It is a simple method in which selected food material is sealed under pressure in a clean, steamed container. This is subjected to high temperature and then cooled. This destroys all the micro-organisms. So the canned food remains uncontaminated for a long time. This mehod is useful in preserving green peas, jams, jellies, etc.

4. Pasteurization

This involves boiling milk at 65°C for about 30 minutes and chilling it. Though boiling destroys most bacteria, the curding bacteria survive. Chilling kills these bacteria. Pasteurization is used only to preserve milk.

5. Chemical Method

The method of preservation which involves use of certain chemicals such as salt, sugar, sodium benzoate, etc., is called **Chemical preservation**. Jams, jellies and pickles are preserved by this method. High concentration of sugar allows minimum moisture and thereby inhibits growth of bacteria. Guava, orange, papaya, grapes and

pineapple are preserved in sugar solutions. Chillies, mangoes, lemon and fish are preserved by salting.

Chemicals like vinegar (dilute acetic acid), citric acid, sodium benzoate and sodium or potassium metabisulphate are good food preservatives for fruit juices, pickles, jams, jellies, salads and squash.

6. Wrapping or Coating method

This method, applicable for eggs and selected fruits, involves coating them with wax or wrapping with parchment paper. The Central Food Technological Research Institute (CFTRI), Mysore, has standardised the procedures for storing several perishable commodities by this method. Fruits like mangoes, sapota, and banana are dipped in wax emulsion containing a small quantity of fungicide. When the material is air dried a thin coating of wax is left on it. Eggs can be preserved by applying a thin coat of oil on the shell.

Activity 8.4 : Preservation of eggs

Materials : *Two eggs, oil or wax, weighing balance.*

Procedure :

1. Weigh the eggs accurately and record their weights. Lable them A and B.
2. Keep egg A as it is. Coat egg B with a layer of oil or wax.
3. Weigh the eggs at 5-day intervals for a fortnight and record the weights.

Give reasons for your findings.

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7. Irradiation Method

This is a recent technique in which food-stuffs are scientifically packed and exposed to gamma rays for a suitable duration. The ionising irradiation penetrates through the packed food materials and destroys all the micro-organisms. Fruits, vegetables, meat and several other food materials can be preserved by this method. However, despite its efficacy, this method is yet to gain wide acceptance because of fears associated with ionizing radiations.

Non-perishable foods such as dried cereals, pulses, flour, spices, sugar are relatively easier to store. They can be stored at room temperature by way of **dry storage**. Bulk storage of these commodities

is done in big storage bins called **grain silos** (figure 8.2). The silos protect them from dust, moisture and pests. They have inbuilt facilities for periodic inspection, fumigation, temperature control, aeration and protection against rodents, birds and animals. There is also facility for easy withdrawal of desired quantities of stocks.

Figure 8.2 : Grain Silos

In our country, gunny bags are also extensively used for storing non-perishable food materials. The bags should be dry, clean and should not be placed too close to the walls. The dampness of the wall gets transmitted to the gunny bags and this promotes microbial activity. The bags can be stacked one above the other with adequate space between the rows of bags. Periodic fumigation is essential to keep the insects and pests away. This is done by using a **fumigant**, which is a chemical that evaporates slowly and kills insect pests without causing damage to food grains. Ethylene dibromide (EDB) and aluminium phosphate are two of the common fumigants used.

For checking the menace of rodents, several types of baits are used. Zinc phosphide or ratafin poisons are commonly mixed with baits to kill rodents. These chemicals are highly poisonous and can cause harm to human beings as well as non-target animals. Hence, baiting should be judiciously done taking utmost precautions.

Besides the bulk methods of preservation discussed above, we practise several simple methods of food storage and preservation at the domestic levels. We must avoid any type of wastage of food material because they are such precious commodities.

QUESTIONS

1. Give a brief account of the internal factors responsible for food spoilage.
2. List the external factors that are critical for proper food storage.
3. Define shelf-life. Give examples for substances that have short shelf-lives.
4. Differentiate between cold storage and freezing.
5. Why do frozen foods last longer?
6. Define dehydration of food materials. Describe the methods by which food materials of plant origin are dehydrated.
7. What is meant by irradiation? How does it help in food storage?
8. Differentiate between perishable and non-perishable food materials.
9. Give reasons for the following :
   (a) lemons and oranges should not be stored in metallic containiers.
   (b) lead containers should not be used for storing food materials.
   (c) perishable food-stuffs should be stored at low temperatures.
   (d) fumigation is essential in storage places.
10. Define the following :
    (a) dry storage (b) pasteurization. (c) enzyme (d) canning.

Chapter 9 : FOOD ADULTERATION

Introduction

Food adulteration can be defined as a process by which the nutritive value of the food is lowered by either addition of an inferior quality substance or by removal of a vital component from the food. The substance which lowers the quality of food material is the **adulterant**. Addition of water to milk or removal of fat from milk are two of the day-to-day examples of food adulteration that we are aware of. The practice of food adulteration is so rampant in our society that there is perhaps no food item free from this act.

Food adulteration can be either deliberate or accidental. If it is a deliberate and intentional act, it is a crime. People resort to deliberate adulteration to increase their margin of profit, *e.g.* : sand, marble chips, pebbles, mixed with cereals and pluses, adding water to milk, mixing inferior quality oil with edible oil. Accidental adulteration is generally due to ignorance, and/or negligence. Common examples of accidental adulteration are the residues of pesticides and insecticides on fruits and vegetables and faulty packing of canned foods.

Both forms of adulteration affect the quality of food. They are dangerous to health as the adulterants may be toxic or may be substances indigestible by our body. They hamper the normal functioning of our body and may even cause ailments or bodily disorders.

Common adulterants : An adulterant is usually a carefully selected material that will not be easily noticed when mixed with the food-stuffs. Table 9.1 is a list of common adulterants in our food.

Food Materials	Adulterant
Cereals, pluses and spices	Sand, marble chips, mud, soap-stone, grit
Dals	Kesari dal, dyes or colouring agents
Wheat flour, maida	Talc and chalk powder
Milk and milk products	Water
Edible oils	Argemone oil, Cheap mineral oils

Mustard, pepper	Argemone seeds, dried papaya seeds
Sweets	Non-permissible colours
Turmeric powder	Metanil yellow & lead chromate
Honey	Jaggery, sugar

Table 9.1 : Common Food Materials and their Adulterants

Here are a few simple tests for detecting adulteration in food.

1. **Vanaspati in ghee or butter :** Melt a teaspoon of ghee or butter sample in a test tube. Add an equal quantity of concentrated HCl and a pinch of sugar. Shake well and leave the test tube in a stand for five minutes. Appearance of crimson red colour in the lower layer confirms the presence of adulterant vanaspati in the sample.

2. **Water in milk** : Put a drop of milk sample on a glass plate and slant it. Pure milk will stay on the surface or flow very slowly leaving a white trail behid. Diluted milk would flow down quickly without leaving a white trail. This test is invalid for skimmed milk supplied by the government dairy. For this, a **lactometer** should be used. Lactometer is a small cylindrical device that measures the density of milk. Unadulterated milk should give a reading of 1.026 in the lactometer.

3. **Argemone oil in edible oil** : Add concentrated nitric acid to about 5 ml of the sample and shake carefully. Appearance of red to reddish brown colour in the acid layer indicates the presence of argemone oil. Argemone oil is very toxic and causes **dropsy** (collection of watery fluid in some parts of the body).

4. **Iron filings and sand in rava :** Move a magnet around the rava sample. Iron filings will adhere to the magnet.

Take a glass of water and gently sprinkle 3–5 gms of rava on its surface. Sand particles will rapidly move to the bottom of the container.

5. **Chicory and powdered tamarind seeds in coffee** : Gently sprinkle the sample on the surface of water in a glass tumbler. Coffee powder stays on the surface while the adulterants sink to the bottom immediately.

6. **Chalk powder, powdered stones in common salt** : Stir a spoonful of sample in a glass of water. The chalk powder turns the water

turbid while the other insoluble impurities settle down. Salt, however, completely dissolves in water.

Can food adulteration be prevented?

The Government of India promulgated an act called the 'Prevention of Food Adulteration Act' as far back as 1954. The Act clearly outlines the minimum standards of quality for foods and also sets stringent hygienic conditions for its sale. The Act has been periodically amended to curb dishonest practices of traders. As the standards mentioned in the Act are mandatory, persons violating them are punishable under law.

Other quality controlling agencies are the Indian Standards Institution (ISI) and the Directorate of Marketing and Inspection (Agmark). In addition to these, the local health departments in the corporation/ municipality conduct periodic surveys and test the food products for their quality. For all processed foods, date of manufacture, date of expiry and quantity must be stamped on the packets. They must also carry the **ISI**, **FPO** or the **Agmark** label to authenticate the quality.

All the above-mentioned laws and standards would be meaningless if the citizens are not aware of them. The eternal vigilance of citizens can minimise the unscrupulous practices of traders and ensure supply of quality food-stuffs. A number of food testing centres are available for testing adulteration of food-stuffs.

QUESTIONS

1. What is meant by adulteration of food?
2. What is ISI mark? what is its role?
3. What is a food adulterant?
4. Name the common adulterants in the following food items:

   (a) wheat flour. (b) tur dhal.
   (c) edible oil. (d) milk.
   (e) mustard. (f) rice.
5. Why do people resort to food adulteration? Are they punishable by law?
6. You are given a sample of common salt containing chalk powder? How do you test for it?

Chapter 10 : FACTORS AFFECTING HUMAN HEALTH

Introduction

Health, as we have already understood, refers to the state of our body. Good health means a body free of diseases and ailments. Good health ensures joy in living. It enables us to perform all the activities such as going to school, studying, playing, working, sleeping well, to name a few. Thus, good health is very essential for a purposeful living.

Factors Affecting Our Health

The important physical and biological factors affecting human health are grouped into two categories.

1. **Intrinsic** factors which are factors within the body such as (a) malfunctioning of some parts of the body, (b) genetic or hereditary factors, (c) hormonal imbalances and (d) allergies.

2. **Extrinsic** factors include those external factors such as (a) malnutrition, eating unhygienic food, (b) micro-organisms, (c) environmental factors, (d) addiction to alcohol, smoking and drugs.

In addition to these, health is also influenced by the state of our mind and the surroundings we live in. The former constitutes the psychological factors and the latter sociological factors. These, however, will not be discussed here.

1. Intrinsic Factors

(a) **Malfunctioning of body parts :** In our daily life we come across with many people with some bodily defects. We see blind men, deaf men, people wearing spectacles, people with cardiac, kidney and other problems. Most of these are defects or disorders caused by malfunctioning of some part of the body. Such defects are called **organic disorders** or **metaboilc diseases.** Table 10.1 lists a few organic disorders and their causes.

	Organic Disorder	Causes
1.	Cardiac failure	Defective heart valves, cardiac muscle malfunction, obstruction to blood flow in coronary arteries.
2.	Kidney failure	Improper functioning of kidney, hypertension, obstruction in urinary tract.
3.	Osteoporosis	Malformation of bones.
4.	Myopia, hyper-metropia	Defective lens in eye and cataract.
5.	Deafness	Malformation of parts of inner ear.

Table 10.1 : Common Organic Disorders and their Causes

(b) **Genetic or hereditary factors** : Diseases which are passed on through successive generations from parents to offsprings are called genetic or hereditary diseases. Examples are **haemophilia** and **sickle-cell anaemia**.

In a person suffering from the haemophilia, the blood does not clot easily. A small injury or a wound results in excessive loss of blood and may even lead to death. This is a rare disease and occurs more in males than in females.

In sickle-cell anaemia, the normally round red-blood corpuscles (RBC) become sickle shaped due to a defect in its haemoglobin. Consequently, the oxygen carrying ability of RBC gets reduced. This impairs the metabolism and renders the patient anaemic. The person often dies before attaining middle age.

(c) **Hormonal Imbalance** : Figure 10.1 shows the location of important glands in our body. Each gland secretes a specific type of chemical substance called hormone. These hormones have vital roles in the normal functioning of the body. Excessive or inadequate secretion of hormones results in many defects and disorders of the body. Some of the common diseases caused due to hormonal imbalances are : **Diabetes mellitus, simple neck goitre, gigantism, dwarfism** and **tetany**.

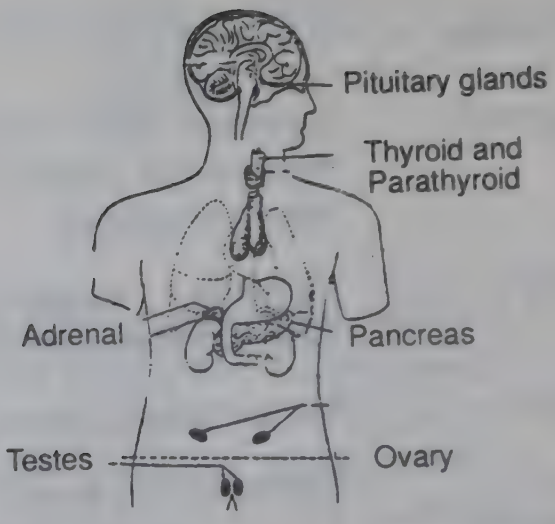

Fig. 10.1 : Location of important Hormonal Glands in the Human Body

Diabetes mellitus is the most common hormonal disorder. It occurs due to deficiency of the hormone, **Insulin**, which regulates the carbohydrate metabolism in our body. In persons suffering from diabetes (diabetics), glucose levels in the blood and urine are high. Constant monitoring of blood sugar levels is very essential in such patients. Administering insulin restores the normal level of sugars and thereby helps in controlling diabetes.

Simple **goitre** is caused by inflammation of thyroid glands due to deficiency of iodine in the body. The hormone **thyroxin** is less in patients suffering from goitre. Though not fatal, it can cause impairment of other metabolisms in the body. Intake of iodine rich food and iodised salt controls the disease.

Pituitary gland secretes a growth hormone. Under-secretion of this hormone in early childhood results in physical **dwarfism** and over-secretion results in **gigantism**.

The parathyroid glands secrete the **parathormone**. Inadequate secretion of this hormone leads of **tetany**, characterised by muscular weakness, muscle spasms, convulsions and loss of appetite.

(d) **Allergic Diseases :** Allergy can be defined as a sensitive reaction of the body against certain substances. Foods such as fish, meat egg, curds, pollen dust, insect stings and certain plants are known to cause allergy in some persons. The common allergic manifestations in the body are : appearance of rashes on the skin, inflammation o

body parts, sneezing and respiratory disorders. Avoiding the **allergen** (allergy causing substance) is the surest way of preventing allergy.

Parthenium is one of the most gregarious weeds and allergen in our country. While the plant causes **contact dermatitis**, its pollen causes respiratory diseases. *Parthenium* eradication is a challenge to our scientists. Each one of us can contribute to this in a small measure by keeping our surroundings free from *Parthenium*.

2. Extrinsic Factors

(a) **Malnutrition** : Malnutrition, as we have already studied, refers to inadequate intake of proper food and nutrients. Over-nutrition refers to excessive intake of food. In Chapter 6, we have already understood the ill effects of under nourishment which lead to various deficiency diseases.

Over-nutrition or over-eating also leads to bodily disorders. The most common disorder is **obesity** due to accumulation of excessive fat in the body. Obesity is an unhealthy condition of the body as obese persons will be inactive and prone to many ailments such as hypertension, diabetes and cardiac disorders. Obesity is more frequent in the middle aged people. It can be prevented by reducing the quantity of food intake. The optimal daily requirement of food is relatively less for the middle aged people. Hence, reducing the quantity of food intake prevents obesity.

Eating unhygienic food, food from road-side vendors (junk food) affects the health of individual. Popcorn, chips, bakery products, snacks, chocolates, fast foods, soft drinks and ice-creams are some of the common junk foods. Habitual eating of such foods will affect our health as most of these foods are only taste-worthy and low nutrition worthy.

(b) **Pathogens** : Pathogens can be defined as disease causing organisms. Several micro-organisms like bacteria, virus, fungi and protozoa affect human health and cause several diseases. These diseases spread from infected to healthy persons through agencies such as air, water, food or by physical contact. The term **Communicable** or **infectious disease** is a reference to all such diseases.

Based on the organism causing the disease, communicable diseases can be grouped into disease caused by

1. Virus
2. bacteria
3. fungi and
4. protozoans and worms

You have learnt about some of these diseases in your earlier classes. Let us learn a little more.

1. **Diseases caused by viruses**: Viruses are organisms smaller than bacteria. They are abundant in air and water. They are very curious 'entities' since we find in them characteristics of both living and non-living things. They cause diseases in plants and animals. Table 10.2 lists the common viral diseases in man, their mode of transmission and symptoms.

	Disease	Agency of Transmission	Symptoms
1.	Influenza	Air	Fever, head-ache, muscular pains, weakness
2.	Mumps	Food & water	Fever, painful swellings in neck near angle of jaw
3.	Measles & chiken pox	Air & food	Fever and red spots on the body
4.	Common cold	Air & water	Burning and tickling sensation in the nose, running nose, sneezing, headache

Table 10.2 : Common Viral Diseases, their Mode of Transmission and Symptoms

One of the recent and most dreadful of viral diseases that is threatening the human race is the **Acquired Immuno Deficiency Syndrome (AIDS)**. It is caused by several strains of a virus named HIV (Human Immuno Deficiency Virus). AIDS weakens and subsequently destroys the immune system (first line of defense in our body against infections) in our body. The body thus becomes very susceptible to all types of infections and diseases. Acute agony and death are inevitable for an AIDS patient.

The spread of AIDS can take place in any of the following ways: (a) By sexual contact. (b) Use of unsterilised needles and syringes.

It is advisable to use disposable needles and syringes. (c) By HIV contaminated blood transfusion. (d) By intravenous drug abuse. (e) By a HIV carrier mother to the foetus.

2. **Diseases caused by bacteria** : Bacteria are micro-organisms which are present everywhere. They are both beneficial as well as harmful to mankind. You have learnt in an earlier class that harmful bacteria cause several diseases in human beings. Diphtheria, tuberculosis, leprosy, whooping cough and cholera are a few of the serious bacterial diseases.

(a) **Diphtheria** : It is a highly infectious disease caused by *Corynebacterium diphtheriae*. The disease is common in infants and children. It affects the respiratory tract and causes soar throat, high pitched cough and nasal discharge often with blood. Timely immunisation of infants with DPT will prevent the occurrence of the disease.

(b) **Tuberculosis** : It is a chronic bacterial disease caused by *Mycobacterium*. It affects people of all age groups. Excessive fatigue, loss of weight, lack of appetite, slight rise in temperature in evenings, husky cough and hoarseness of throat, night sweating are the characteristic symptoms. Isolation of the patient in a sanatorium for treatment is advisable. BCG vaccine confers partial protection.

(c) **Leprosy** : It is caused by *Mycobacterium lepre*. The disease affects skin and nerves. In the initial stages, faint pink insensitive patches appear on the skin. If not treated early, the patches increase both in size and number. In advanced stages, deformity of organs such as fingers, toes and ears occurs.

Lack of adequate knowledge is the cause for the unnecessary fear we have about the disease. The following facts about leprosy should dispel most of our fears and apprehensions about the disease : (i) It is not hereditary. (ii) It is not as infectious as it is believed to be. Only repeated contact is not advisable. (iii) The disease can be cured.

(d) **Whooping cough** and **Pertussis** : Caused by the bacterium *Bordetella pertussis*. It usually affects children below five years. Inflammation of nose and eye balls, vomiting and dry cough are common symptoms. Immunization of infants ensures protection from the disease.

(e) **Cholera** : It is an acute infectious disease caused by the bacterium *Vibric cholerae*. The symptoms are severe diarrhoea and vomiting with massive loss of body fluids and development of muscle cramps.

3. **Diseases caused by Fungi** : Fungi, are a group of saprophytic or parasitic organisms. Some of them cause diseases in human beings. Infections are caused and transmitted by spores which are in abundance in air. Fungal infections are common on skin, lungs and ears. The term **mycosis** is generally referred to diseases caused by fungi in man.

Ring worm (**eczema**) and **candidosis** are the common fungal diseases on the skin of man. Ring worm is caused by fungi belonging to a group called **Dermatophytes**. It is a contagious disease characterised by the appearance of round red patches on the skin. Children often get infected by this disease. **Candidosis**, another skin disease is caused by a type of yeast, *Candida albicans*. Allergic pneumonia is caused by a soil fungus, *Aspergillus fumigatus*.

Food poisoning, which we often read about in newspapers, is caused by both bacteria and fungi. These micro-organisms release poisonous substances called **toxins** into the food. Consumption of such toxic foods causes food-poisoning. Canned foods often get contaminated by disease causing micro organisms due to unscientific methods of processing and packing. Table 10.3 lists the common diseases due to food poisoning.

Disease	Causing organism	Food items contaminated
Salmonellosis	*Salmonella* (bacterium)	Egg, meat and milk
Botulism	*Clostridium botulinum* (bacterium)	Canned foods
Mycotoxicosis	*Aspergillus* (fungus)	Cereals, Vegetables and groundnuts

Table 10.3 : Food poisoning – diseases, causing organisms and Food Items contaminated

4. **Diseases caused by protozoans and worms** : Parasitic protozoans cause several diseases in man such as malaria, amoebiosis, giardiasis and kala-azar.

Malaria is caused by the protozoan parasite *Plasmodium vivax*. Common symptoms are : the patient feels severe chills, acute headache and nausea. Intermittant fever appears slightly later followed by very rapid pulse beats.

Amoebiosis is caused by another parasitic protozoan, *Entamoeba histolytica* which lives in the human intestinal walls. Severe diarrhoea and mucous secretion, often blood stained in acute infections, are characteristic symptoms.

Giardiasis is caused by the genus *Giardia* which lives in the small intestine of man. Abdominal pain, diarrhoea, hyper acidity and intestinal disorders are characteristic symptoms.

Kala-azar is an infectious disease caused by *Leishmania donovani* – a parasite that causes infection in spleen, liver and bone marrow. The affected persons experience irregular fevers of chronic nature, enlargement of spleen and liver. The patient appears emaciated, anaemic with black pigmentation on the skin.

Parasitic worms such as round worms (*Ascaris lumbricoides*), hook worms (*Ancylostoma duodenale*) and filarial worms (*Wuchereria bancrofti*) cause diseases in man. **Ascariasis** is caused by the round worm. Abdominal pains, loss of appetite, weight loss and weakness are symptoms of round worm infection. Hook-worm infection causes **anaemia**. Filarial worm causes the disease **filariasis** or **elephantiasis**. The limbs of persons affected by elephantiasis are swollen (many times the size of normal limbs). The disease is common in the coastal regions of Orissa, Karnataka, Kerala and Andhra Pradesh.

(c) **Environmental Factors** : In addition to the above causes, there exist several diseases in mankind for which man himself is the cause. No doubt advances in science and technology have made life better and easier for us. Paradoxically, they have also brought sufferings in human beings. The natural environment is under acute stress due to hectic industrial activity which is polluting the environment. The air we breathe, the water we drink, the soil in which we grow plants are all adversely polluted these days. These environmental factors cause several diseases. In addition to these diseases people working in certain

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industries are prone to specific types of ailments called **occupational hazards**. People working in mines, cement industries and those engaged in grinding and crushing of stones inhale very fine dust particles while at work and become prone to serious disorders of the respiratory system. **Pneumoniasis silicosis**, are very common in such people. People working in asbestos factories develop **asbestosis**. Similarly, workers in textile mills inhale plenty of cotton and wool dust which causes serious respiratory disorders.

(d) **Addiction to alochol, tobacco and drugs** : Another major cause for human misery is his habits. Addiction to alcohol and tobacco, drug abuse are very common evils in mankind today. They are habit forming substances which make a person increasingly dependent on them. Let us understand the harmful effects of some of these habit forming substances.

(a) **Alcohol** : Consumption of alcohol or alcoholism is one of the common social problems throughout the world. An alcoholic is a social demon, who not only kills himself but also makes the lives of others miserable. Many alcoholics indulge in anti-social activities and perpetrate crime in society. Drunken driving is responsible for a large number of road accidents. This isbecause alcohol increases the **reaction time** (the time we take to respond to an emergency situation is called reaction time). In normal human beings it is about two-thirds of a second. In an alcoholic, the nervous system is affected under the influence of alcohol, hence the reaction time increases. Thus it takes an alcoholic longer time to take note of an emergency and plan preventive o evasive action.

The effects of alcohol in our body are : (i) it causes cirrhosis of the liver. (ii) it causes gastritis and ulcers. (iii) it impairs the function of the brain and the nervous system, weakens memory and self-control. A alcoholic fails to distinguish between good and bad; right and wrong. H thus becomes an animated villain or criminal.

(b) **Tobacco** : Tobacco contains several alkaloids. Among them i **nicotine** which is both a stimulant and a **carcinogen**. Consumption tobacco is by way of inhalation of smoke through beedi, cigarette an pipes. Tobacco chewing and inhalation of powdered tobacco (snuff) a other common methods of tobacco consumption more often see among villagers. All forms of tobacco uptake release nicotine into o

body. Tobacco smoke contains carbon monoxide and hydrogen cyanide along with nicotine. Accumulation of carbon residues such as tar in the throat and lungs affects the respiratory system. Dry cough and constant throat irritation are common among tobacco users. Excessive smoking weakens the lungs. In fact, habitual smokers run a greater risk of lung cancer than non-smokers. Several cardiac disorders such as palpitations, irregular heart beats, hypertension are also attributed to smoking. Tobacco chewing is an equally dangerous habit. It makes the tongue insensitive to taste and is known to be the cause of several types of oral cancers. During pregnancy, consumption of tobacco in any form is highly dangerous as it seriously affects the normal growth of the foetus.

A smoker is not only killing himself but is also transferring the smoking related risks to other non-smokers around him. The non-smokers inevitably inhale smoke along with the air they breathe. They are thus **passive smokers** and also run the risk of contracting smoking related problems. For this reason, smoking in public places, government offices, official meetings and while travelling in bus, train or aeroplane is forbidden. To discourage people from smoking, a statutory warning is printed on all cigarette packets. This warning is more often read by non-smokers than smokers!!

(c) **Narcotic and psychotrophic drugs** : Substances which affect the human brain and nervous system, blunt his senses and make him completely insensitive are collectively called **narcotics** or **psychotropic drugs**. These are generally of plant origin. The use of narcotics by teen-agers is a very serious social problem in many countries. They are highly habit forming drugs. People who take to this initially for fun, thrill and excitement usually end up as staunch addicts to these substances. Consumption may be either by smoking or by injecting the substance into our body. Drug addicts are social evils who seldom come back to leading a normal life. Resist it at the first instance and save yourself from becoming a victim of drug abuse. Common narcotic drugs are morphine, heroin, opium, marijuana, cocaine, LSD and hashish.

Tips for Good Health

The five basic principles which will ensure good health are :

(a) **Proper diet** : The food we take must be hygienic and contain adequate amounts of all the essential nutrients. Balanced diet ensures

this. Drinking filtered or boiled water safeguards us for many water borne diseases.

(b) **Cleanliness** : Cleanliness of the self and of the surroundings are both very important. Clean environment prevents the occurrence and spread of diseases.

(c) **Immunisation** : Timely immunisation of infants and children will help fight several infections and diseases.

(d) **Cultivation of good habits** : Early to bed, early to rise, adequate sleep, timely intake of food, good behaviour, self-discipline, sincerity and dedication in everything we do are some of the good habits that contribute to our health.

(e) **Physical exercise** : Regular physical exercise and games keep both our body and mind fit.

QUESTIONS

1. Define health. Mention the factors affecting human health.
2. What is an organic disorder? Give two examples and their causes.
3. Write a labelled diagram to show the important harmonal glands in our body.
4. What is obesity? How can it be prevented?
5. Define virus. Name three viral diseases in human beings.
6. What is AIDS? What causes it?
7. What are the misconceptions associated with AIDS?
8. Name three important bacterial diseases in human beings and the names of bacteria causing them.
9. Name any two harmonal disorders in human beings. Explain their causes.
10. What is allergy? How can it be prevented?
11. What is an occupational disease? Mention any two and write their causes.

12. What are narcotic drugs? Why are they called habit forming substances?

13. Name the basic principles that ensure good health.

14. Name the micro-organisms that cause the following :
    (a) Kala-Azar. (b) diphtheria.
    (c) salmonellosis. (d) aspergillosis.
    (e) candidosis.

15. Define the following :
    (a) toxin. (b) botulism. (c) carcinogen.
    (d) hormone. (e) allergen. (f) passive smoker.

16. Give reasons for the following :
    (a) eating junk foods regularly is not advisable.
    (b) an AIDS patient is prone to many diseases.

1. Glycine	11. Cysteine
2. Alanine	12. Methionine
3. Valine	13. Proline
4. Leucine	14. Aspartic acid
5. Iso-leucine	15. Glutamic acid
6. Serine	16. Histidine
7. Threonine	17. Arginine
8. Phenyl-alanine	18. Lysine
9. Tyrosine	19. Glutamine
10. Tryptophan	20. Asparagine

Protein aminoacids in our Body
[This is only for Additional Information]

VITAMINS WITH THEIR SCIENTIFIC NAMES & DAILY REQUIREMENTS FOR 13-15 YEARS AGE GROUP

VITAMIN	SCIENTIFIC NAME	DAILY REQUIREMENT
VITAMIN A	RETINOL	750 mg
VITAMIN B5	THIAMINE	1.3 mg
VITAMIN B2	RIBOFLAVIN	1.6 mg
VITAMIN B4	NICOTINIC ACID NICOTINAMIDE	1.8 mg
VITAMIN B6	PYRIDOXIN	SMALLER QUANTITIES
FOLIC ACID	B COMPLEX	50-100 mg
VITAMIN B12	CYANOCOBALAMIN	0.2 TO 1mg
VITAMIN C	ASCORBIC ACID	40 mg
VITAMIN D	CALCIFEROL	200 IU
VITAMIN E	TOCOPHEROL	TRACE AMOUNTS
VITAMIN K	PHYLLOQUINONE	TRACE AMOUNTS

* THIS IS ONLY FOR ADDITIONAL INFORMATION

POPULATION EXPLOSION

Year	Estimation of World Population (in Millions)
B.C. 4000	85
A.D. 1	250
A.D. 1650	550
A.D. 1750	750
A.D. 1800	950
A.D. 1850	1,200
A.D. 1900	1,550
A.D. 1925	1,900
A.D. 1950	2,486
A.D. 1975	4,022
A.D. 1990	5,438
A.D. 1995	5,961
A.D. 2000	6,493
A.D. 2070	25,000
A.D. 2100	48,000

Kaveri River

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